THE

ELECTRICAL REVIEW.

VOL. LVIII. MARCH 16, 1906. No. 1,477.

ELECTRICAL REVIEW.

Vol. LVIII.] CONTENTS: March 16, 1906. [No. 1,477.

	Page
Observations on the Teaching Profession	413
A Contribution to the Theory of the Single-Phase Induction Motor (*illus.*) (*concluded*)	416
Correspondence	417
Legal	421
Our Legal Query Column	422
Parliamentary	423
Business Notes	423
Rotating Tower Crane for the Dublin Port and Docks Board (*illus.*)	431
Two-Phase Alternators for Johannesburg Municipality (*illus.*)	432
British-Made Carbons (*illus.*)	434
City Notes	438
Electric Tramway and Railway Traffic Returns	442
Stocks and Shares	442
Share List of Electrical Companies	443
The Globe Photometer (*illus.*)	445
Proceedings of Institutions:—	
Waste in Incandescent Electric Lighting (*illus.*) ...	447
New Electrical Devices, Fittings and Plant (*illus.*)	450
Reviews	452
Published Specifications	452

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.
Telephone No. 933 Holborn; 4425 Central.

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades,
AND HAS
BY FAR THE LARGEST CIRCULATION
of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—In Great Britain, Post Free, per Year, 19s. 6d. To all other countries, per Year, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street Paris: VEUVE J. BOIVEAU, 22, Rue de la Banque. Berlin: ASHER & Co., 13, Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE

UNIVERSAL ELECTRICAL DIRECTORY

1906 Edition

NOW READY.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

OBSERVATIONS ON THE TEACHING PROFESSION.

WE now and then see an advertisement in the technical papers of a vacancy at some Institution where the higher branches of technology are taught, and where a chief of department is required. The salary varies, say, from £200 to £1,000 a year. At nearly every place one condition of the appointment is that the successful candidate shall devote the whole of his time to the duties of his post. This means that he is not to engage in, or undertake, any other work of a lucrative nature, whether temporary or permanent, even though his duties would not only not be interfered with, but the experience he might so gain might, and probably would, *increase his efficiency as a teacher*. We would particularly draw attention to the words in italics.

Our technical institutions, where the higher branches of technology, electrical or otherwise, are taught should first of all have competent teachers. It is not to be expected that good results can be obtained unless the teacher, whether he be termed lecturer or professor, is himself the master of his subject.

It is not our purpose here to dilate upon salaries paid to teachers. We will take it for granted that each institution pays in proportion to its means and selects the most competent candidate.

What we do propose to discuss is the treatment of teachers which is most likely to keep them competent or make them more competent for the work they are engaged in. We also wish to discuss the duties, or what should be considered the duties, of such teachers. Let us consider the latter proposition first.

What should be the duties of a man who is responsible for a department of technology in one of our Technical Institutes or Colleges?

We may take it that his first and foremost duty is to make the best use of all the means at his disposal to render his department as efficient as possible, so as to induce good students to attend the various courses. This, of course, implies well-organised laboratories, and lectures carefully prepared to suit the requirements of the students. He should also be able to guide and, if necessary, instruct his assistants in the conduct of their respective classes.

To give our ideas a concrete form, we will consider the case of a department of electrical engineering. This should consist of laboratories equipped with various electrical machines and apparatus to enable practical instruction to be given on the subject matter of the lectures; suitable lecture courses should be arranged to meet the requirements of the students, and special courses dealing with the higher branches of the particular industries of the locality.

It is obvious that the head of the department has duties of no mean order to fulfil. The work of the department must be properly distributed between his assistants and

himself, and be so arranged that he can not only perform his own share, but also see that his assistants perform theirs to his satisfaction.

Each class of students, from the lowest to the highest, must be made to feel and know that the instruction is to be given well and effectively.

Now, especially among the best students, it is of the highest importance that the lecturer should be able to impress them with the idea not only that he is conversant with the theoretical aspect of the subject, but that they can safely appeal to him on practical points also. This requires that the lecturer should have a special practical acquaintance with the local industries. It is not necessary that he shall at some time actually have done the work himself, but that he should have critically examined work in progress and be capable of describing it clearly in every detail.

We are beginning to require a great deal of a man for £200 a year. How are we to get it? In nine cases out of ten, nay, in 99 out of 100, the successful candidate for such a position cannot meet all these requirements, and should be educated up to them. How?

Suppose that the advertisement had distinctly stated that the gentleman appointed would be allowed to engage in consulting work provided such did not interfere with the duties of his appointment, and that preference would be given to candidates capable of doing such work. What would the effect of such an appointment be?

The conditions of the appointment would, except during vacations, preclude other than local consultations. The local employers would prefer such a man to an outsider, on account of his accessibility. If he proved himself to be a really capable man, he would rapidly become well acquainted with local industries, and bring about a closer relationship between the industries themselves and the Institution. Employers would encourage their employés to attend his classes, in order that they might become more proficient at their work; and last, but not least, the lecturer himself would not be so prone to be constantly on the outlook for a better appointment.

Ten years ago our arguments might have been regarded with suspicion, but now it is very gradually becoming recognized that the barrier between the teacher and the worker should not exist.

At the Birmingham University, Mr. Kapp was recently appointed to the Chair of Electrical Engineering on such an understanding, and in consequence of an advertisement such as we suggest.

If other Institutions proceeded on similar lines, there would be no lack of applications from capable men who would not shirk their duties, but who would make the most of their opportunities and draw good students to their classes, and there would be a harmonious blending of theory and practice, which can only be effected by close intimacy and a mutual confidence between the manufacturer and the teacher.

The Ethics of Electricity Meters.

The average consumer looks on his meter as his natural enemy, placed on his premises by an unscrupulous authority to get the better of him. He forgets that the mirror has an obverse side, and that the meter may occasionally be his good friend at the expense of the said authority.

Mr. G. A. Barrett, in a paper recently read before the North-West Electrical Association in Chicago, makes a few suggestions of a useful nature by which the consumer is to be inspired with confidence in his meter, whilst the meter shall be checked from turning on its employer.

From the station engineer's point of view the first is perhaps just as necessary as the last. The collective goodwill of the consumers is an asset perhaps nearly equal to the light load loss of the meters. Whether it can be secured by employing a polite, tactful and gentlemanly official whose soft answer shall turn away the consumer's wrath, is doubtful. It depends so much on the consumer and on the particular offence of his meter. The consumer is to have the matter explained to him frankly and what it is proposed to do, and may be invited to accompany the Admirable Crichton to assist in the test if he cares to—*i.e.*, like the "Ass and the Gate," he is to be led up to it, and made curious, if not interested. We are afraid that John Bull is not as scientifically inclined as Jonathan; if he is not satisfied he is more inclined to kick his meter out and revert to candles than to go into the whys and wherefores. The moral is to provide a reliable meter and a system of charging which the consumer understands.

With regard to the treatment of the meters, Mr. Barrett advocates a station test before placing them in service. We believe this is done almost generally here, and if not it ought to be, as meters are frequently upset by travelling. The genial wireman, too, who uses nails for fixing a meter, or what is known as a "Brummagem screw," (hammering in a screw the greater part of the way, and then finishing up with a screwdriver), should not be encouraged; nor should the meter be fixed until the wiring is entirely finished. Further, on a three-wire system with earthed middle-wire, a two-wire meter should be in the outer wire in case the middle wire becomes earthed in the building, when there may be no registration.

The testing of meters on consumers' premises is a difficult and serious problem. In Mr. Barrett's opinion it is not necessary, in the majority of cases on lighting load, to do more than clean and adjust for light load twice a year. At full or medium load the meter is usually fairly correct; it is the light load errors that cause the trouble.

To clean up, all that is required is to remove dust and cobwebs, clean the commutator, and insert a new jewel and pivot if necessary: a rough test can be made with a voltmeter and stop-watch, approximating the current from the nature and number of lamps burning. We doubt whether this approximation would be correct here unless under a system of lamp control such as that described by Mr. Wilkinson. Such a test should occupy at most thirty minutes.

To check properly and correct the light load losses, Mr. Barrett suggests that all meter records should be examined and scrutinised by an expert in the meter department, whose special function it would be to discover sluggish meters by his knowledge of the meters, their weaknesses, and the conditions under which they might become faulty. The consumer himself may be trusted to report the overreadings, but it is quite possible that the money saved by proper localisation of inaccurate light load readings might pay for the salary of the official who did the work, many times over.

Iron Losses.

In the discussion on Mr. Fynn's paper at the I.E.E. last week, Mr. Mordey referred to the greater loss due to the eddy currents as armature plates became thicker. He observed that with the high magnetic densities which were now in use, the difference in the losses due to this cause was, for different thicknesses of plates, very pronounced. In giving figures to prove his point, Mr. Mordey plaintively remarked that no one listened to his advice about these matters, though he had been trying to instruct people for a long time. But the fact is that his remarks presented only half the truth. Apparently it escaped the speaker's notice that armatures are composed partly of paper or other insulating material placed between the iron plates, and that any reduction in the gauge of the plates inevitably presses up the magnetic density in the iron, for the simple reason that more of the total space is then occupied by insulating material. Accordingly, a test on two plates of different thicknesses, pressed up to the same magnetic density, will show a greater difference in the losses due to eddy currents than a test on two finished armatures having plates of different gauge, in both of which the total induction is the same. It is a test of the latter description that should guide designers in this matter, not the test proposed by Mr. Mordey, and it will be found that the difference in losses for different thicknesses of plates is not nearly so great as his test would lead us to believe.

Science and the Industries.

The various letters that have recently appeared in our contemporary, the *Times*, under the above heading, and the comments made thereon in several papers, though freely described with the conventional adjective "interesting," have taken a somewhat regrettable and futile turn. The pother has arisen over the proposal to which we referred in a recent issue, that the present "jubilee" of the coal-tar colour industry shall be commemorated in the shape of a testimonial to Dr. W. H. Perkin, the discoverer of the first "aniline" dye. Dr. Perkin is a man who has received no social "honour" or recognition for the epoch-making discovery of his boyhood, and now protests are being raised against any celebration of his inventive genius on the ground that the trade to which he gave birth is moribund in England, although flourishing and profitable in Germany. In other words, it is hinted that an inventor performs no public service to his native land, unless compatriots over whom he has little or no control possess the intelligence and the capital needed to bring his invention to a commercially successful issue. The cynical doctrine that nothing succeeds like (or but) success is not often put forward so shamelessly; and it is seldom, we believe, that a discussion of this kind is carried on in reputable journals in so personal a manner. Quite possibly some of the writers are not fully aware of this aspect of their letters. Dr. Perkin's name is inevitably being bandied about, and the late Prof. Jebb is being blamed for not having had an exhaustive knowledge of the budding mining engineers of the country; but, apart from this, the decadence of the colour trade is being attributed to the action of certain manufacturers or the ineptitude of certain organic chemists. The firms now or formerly engaged in the business can be counted on the fingers of one hand, and the members, or their successors, are with us still; the chemists are with few exceptions in our midst, scarcely exceeding their late employers in number. We should not care to say in print that all or most of some half-dozen living chemists are ignorant or incapable men. As a matter of fact, after the first boom, the employers did not have control of sufficient capital to develop their businesses, and never possessed that prescience which distinguished the prophets of old; while the chemists were employed almost entirely as works or departmental managers (really as foremen), and had no leisure to institute research. Moreover, it seems to be generally overlooked that at the time when our manufacturers and their staffs were pioneers, very large profits were accumulated in the colour industry; although it is necessary to admit that this occurred mainly during and immediately after the Franco-German war, when they had virtually no foreign competitors.

The phenomena of the colour trade are, of course, only taken as symptomatic of all industrial businesses in this country which are not excessively remunerative to their proprietors; and, therefore, the British patent laws are once more brought forward as the cause of foreign successes. There is sufficient truth in the argument to make it difficult to refute; although it has been neatly pointed out by the original correspondent of the *Times* that had there ever been any belief in the value of research and in the protection afforded by patenting, the country would have insisted on a proper alteration of those laws. More to the point is the assertion made by some of the papers to the effect that under the conditions prevailing in this country, pioneer work—*i.e.*, the utilisation of research—does not pay; that profits are not obtained by the first man or firm in a new business, but by the second or third. One of the leading examples taken to prove this view is rather unfortunate; for the position hitherto held, and still retained by subjects of the British Crown as manufacturers of iron and steel, has been largely due to the great initiating intellects of the technical men engaged in it, to the receptivity of a sufficient number of the masters, and to their willingness to put their discoveries into the common pot of the Iron and Steel Institute.

Nevertheless, the assertion is largely true that much more money is amassed by the merchant than by the manufacturer, and it indicates a lamentable state of affairs. The majority of successful men in the City carry out no operation of value to the nation, or to anybody but themselves and their families. The man who simply buys and sells a thing, or a piece of paper representing a thing, who even buys and sells a thing that may never exist, performs no useful service; he does not create or improve the quality of any article. He does not even utilise his capital in holding a stock of some commodity irregular in production, finally selling it at a reasonable price when the failure of natural supplies is inconveniencing his fellows. He does not pay wages or assist the ratepayers, but his profits are out of proportion to those made by the manufacturer or refiner who creates—who, by virtue of his factory, finds employment for many families, helps to retard the fall in the birth-rate, and is forced to contribute, out of all fair proportion, to the extravagant expenditure of his local authority. Hence the manufacturer naturally strives to reduce his expenses, partly by an unrestrained system of price cutting, and partly, judging from the letters in the *Times*, by starving or abolishing that department of his works which alone can ensure economy in important details, or assist in his taking up some new branch of his industry when the present one ceases to afford any profit at all.

Incandescent Lamps in Coal Mines.

In the *Transactions* of the South Yorkshire Association of Mining Students we find a paper by Mr. Hugh Ross on the merits of the electric lamp in coal mines, in which it is stated—

> That ignition will *not* take place even though the bulb of an electric lamp be broken in an explosive mixture, has been clearly demonstrated by Mr. W. G. Wood, who made many experiments in mixtures of coal gas, and mine gas and air with incandescent lamps varying from 1 to 16 c.p. and at 4 to 110 volts. Out of many experiments no ignition of the explosive atmosphere occurred, although faulty safety lamps under the same conditions at once exploded the mixture.

Now this is a cheerful and comforting statement, and one that would gladly be accepted but for the fact that the next succeeding leaf, containing a paper by Mr. B. Hadfield on the electric lamp, states that "experiments have shown that if the glass becomes broken in an explosive mixture of firedamp and air, the mixture *may* be fired." The italics are ours in both cases.

Of course, both statements cannot be true. Either ignition will or will not take place, and it would be well that this question should be definitely and authoritatively settled, for if an ordinary bulb lamp will not ignite a gas and air mixture when the glass breaks, there is no use in improving upon it in respect of safety, whereas if there is danger in fracture of the bulb this danger can certainly be minimised, at some expense it is true, and the lamp put out of action. There are contrivances by which the electric lamp will safely indicate the presence of firedamp, an auxiliary red lamp being lighted by means of a diffusion cell and mercury contact. This Mr. Hadfield, who seems to be opposed to electric lamps, ignores.

Now, it is quite true that the ordinary safety lamp may indicate the presence of firedamp, but this indication is not a very pleasant thing to observe, for a very small defect in a safety lamp may cause disaster; another writer on lamps claims that it is not necessary that they should indicate the presence of gas, for this ought to be found during the frequent compulsory official inspections of the working places.

Mr. Hadfield backed up his statement by reference to the Commission on Electricity in Mines, who proved that under certain conditions an electric lamp would ignite gas. There is no agent so certain of action in igniting an explosive gaseous mixture as is electricity. It is used by the analyst in eudiometric examinations, by the gas engineer, and by the motor-car maker. The electric spark is very certain in action, and it is difficult not to think that it would ignite an explosive mixture if it occurred in that mixture. The superiority of the electric light is, however, so great in comparison with the ordinary lamp that efforts should be made to place its safety beyond dispute.

D

A CONTRIBUTION TO THE THEORY OF THE SINGLE-PHASE INDUCTION MOTOR.

By VAL. A. FYNN.

(*Concluded from page* 410.)

In conclusion, the author thinks that the main features of his theory of the single-phase shunt induction motor could be more easily impressed on the memory by representing diagrammatically, for a given direction of rotation and for some particular instant, the directions of the various fields, E.M.F.'s and currents involved, much in the same way as is usual in the case of continuous current machines. It is hoped that the figs. 14 to 22 will achieve this object. The first three figures represent the well-known conditions obtaining in continuous current generators and motors. Gramme-ring windings, all wound in the same direction, are supposed to be made use of in the figs. 14 to 22; for the sake of clearness they are only indicated in the first three.

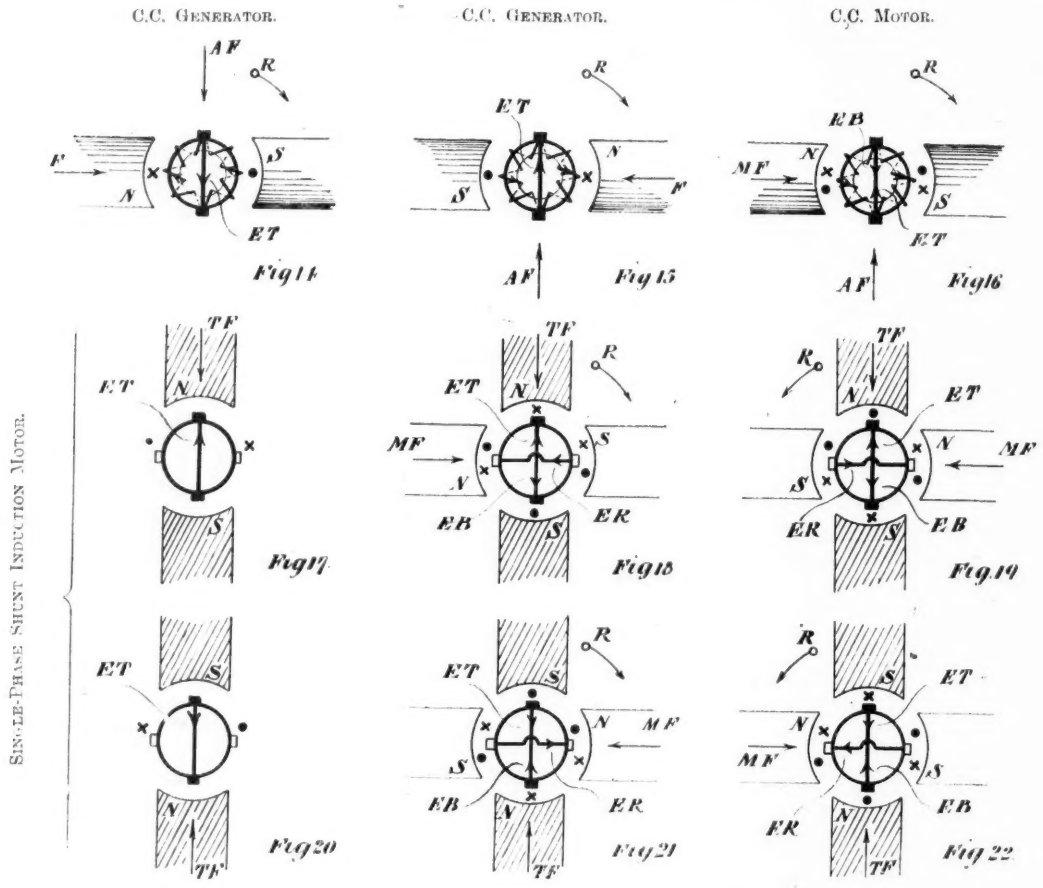


Fig. 14 shows a continuous current generator having a field F of the direction indicated by the arrow. Assuming a direction of rotation R, the direction of the working E.M.F. (E T) generated in the armature winding will be given by the arrows shown in that winding. In the case of continuous current machines the current will always be in phase with its E.M.F., and these arrows will, therefore, also show the direction in which the current will flow through the armature winding. The conditions will not be altered in any way if the brushes be short-circuited, and the current will flow from the top to the bottom brush, this armature current setting up a cross field in the direction A F and causing a distortion of the main field indicated by the shading on the poles N and S. This particular distribution of current along the armature conductors is also indicated by the cross and dot placed in the air-gap. Fig. 15 shows the conditions prevailing for a reversed direction of the generator field, and fig. 16 illustrates the state of things in a motor. Here again the brushes are shown short-circuited; the working E.M.F. (E T) is supposed to be introduced by means not indicated. The brushes have in all cases been shown short-circuited, so as to allow of a more direct comparison with the shunt induction motor; it need hardly be said that this does not correspond to continuous-current practice. Now the direction of this working E.M.F. (E T) is such as to send the current in at the top brush and out at the bottom brush; the distribution of the current along the armature conductors is shown by the dot and cross placed in the air-gap *below* the horizontal centre line. The direction of the motor field being given by M F, the motor will revolve in the direction R setting up a back E.M.F. (E B) opposed to the working E.M.F. (E T), the armature current will flow against this back E.M.F., the distribution of which is shown by the cross and dot in the air-gap *above* the horizontal centre line. This back E.M.F. is the E.M.F. generated in the rotor winding by its revolution in the field M F, and its direction can be ascertained from fig. 14. The cross field is indicated by A F and the distortion it causes by the shading of the poles N and S. The meaning of the dots and crosses in the air-gap being thus absolutely defined, the armature winding itself can be omitted in the following figures without fear of confusion.

In examining the conditions prevailing in an alternating current motor, and in applying to it the rules laid down in figs. 14, 15 and 16, we have in addition to take phase differences into account. Now the question arises as to how a phase difference is to be correctly expressed by means of a direction only in such diagrams as figs. 14 to 16. Taking, for instance, the well-known case of the E.M.F. of self-induction, we know that the latter lags by 90° behind the current to which it is due, and we also know that such an E.M.F. always *opposes* any change of that current. It will therefore be correct to represent this lagging E.M.F. as opposed to its current, and generally it will consequently be correct to represent a lag by an opposite, and a lead by the same direction.

Taking fig. 17, and assuming the transformer field T F to have at the instant chosen the direction indicated by the arrow,

and it being known that the undulations of this field will set up an E.M.F. in the rotor lagging by 90° behind this field, it is clear that this E.M.F., which is our working E.M.F. (E T), must be represented as opposed to the field T F; its distribution along the armature is shown by the dot and cross in the air-gap *above* the horizontal centre line. We will assume the working current to be in phase with E T (in practice this is nearly true, as has been shown); this current will therefore flow in the same direction as E T—that is, from the bottom brush to the top brush. If we now give this motor an initial impetus in the direction R (fig. 18), and short-circuit the field brushes (white brushes), the rotation of the armature conductors in the field T F will generate the E.M.F. (E R) along the motor field axis. This E.M.F. will be co-phasal with T F; its direction can therefore be ascertained directly from fig. 14. This E.M.F. will produce a magnetising current and a field both lagging behind it by 90°, and therefore opposed to it in direction, as shown by arrow M F. The torque is produced by the current flowing by way of the armature brushes (black brushes) in the direction E T, and by the motor field M F. A reference to fig. 16 will show that the conditions brought about by the initial impetus given to the motor are really such that the machine *must* continue to run in the same direction; but the rotation of the rotor conductors in the field M F will also generate an E.M.F. in phase with this field, and along the axis of the armature brushes: this is E B, the back E.M.F., and a reference to fig. 14 will at once help to determine its direction. The latter is given by cross and dot in the air-gap, and *below* the horizontal centre line; it is seen that E B in fig. 18 must be opposed to E T, which again agrees with the conditions prevailing in the continuous-current motor (fig. 16).

If the motor is given an initial impetus in the opposite direction, as shown in fig. 19, the same line of thought will show that it must also continue to run in that opposite direction, and will bear out all the other main features of the theory which has been put forward. In fig. 20 an instant has been chosen when the transformer field is of a direction opposed to that assumed in fig. 17, and it will be seen by following out the various effects in the way already indicated for figs. 17 and 18, that this alteration in the direction of the transformer field is without effect on the direction of rotation or on the general operation of the motor.

The author has only touched lightly on alternate current series motors, on which subject a good deal might be said. When such motors are looked upon from the point of view advocated in this article, it will be found that much of their apparent complexity entirely disappears, and they become simple to understand and to predetermine. The author proposes to deal with these motors in a subsequent contribution.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The Ondoscope.

I notice in your issue of March 9th a description of what is called the Ondoscope, and I feel sure that you will grant me some of your valuable space to rectify a few of the statements which appear in this article.

In the first instance, the instrument was not "invented" by Mr. Ruhmer, of Berlin (who, by the way, does not hold the position of Professor), but represents a modification by Ruhmer of the original instrument designed for the purpose of obtaining curves of variable currents by Mr. Gehrcke.

Then as regards its introduction, I would say that the instrument was brought over by me in July, 1905, and was shown by my firm at the Royal Institution and the Physical Society, besides having been demonstrated at our showrooms for a considerable time. I believe it was in consequence of some of the advertisements which my firm inserted in various scientific and medical journals (your own included) that Dr. Morton called upon us and purchased one of these oscillograph tubes, and he afterwards informed us that he was using this tube for a Paper to be read at the meeting of the British Electro-Therapeutic Society in conjunction with Dr. Lewis-Jones. I feel certain that neither Dr. Lewis-Jones nor Dr. Morton lays claim to having introduced this device, and that it must have been a mistake on the part of the writer of the article in the *Archives d'Electricité Medicale* to ascribe the credit for this extremely ingenious and convenient oscillograph to Dr. Lewis-Jones.

We likewise would say that the "valve tube" for radiographic work has been a commercial article with us, and has been sold in numbers, during the last four years at any rate, and that finally the application of the oscillograph to the measuring of currents in the high potential circuit of coils and transformers has also been commercially known since the introduction of the oscillograph by Gehrcke and Ruhmer.

One more interesting application of the instrument is due to Ruhmer, who has attempted to use it in the antenna circuit of receiving and sending stations of Hertzian wave installations for the purpose of tuning.

A. W. Isenthal.

London, W., *March 12th*, 1906.

P.S.—I enclose two commercial circulars describing the vacuum oscillograph and vacuum milli-ampere gauge.

[In the *Archives* Dr. S. Leduc thanked Dr. Lewis-Jones for enabling him to *describe* "this new instrument."—Eds. E.R.]

How to Screw Conduits.

It has occurred to me after reading the articles and correspondence on the above subject that something has been missed. Leaving aside the question of the superiority of screwed tube against contracting nipples, the whole question seems to turn on this, "What is wanted is a system which, whilst ensuring continuity, is proof against damage by rust."

A contractor settles on one system or the other, and the tube is delivered on his job to be cut up in short pieces, each of which is either pushed or screwed into a fitting of some sort. In either case the tube is filed clean in one case to ensure continuity, and in the other to start a thread. Now what I want to point out is this: in the majority of installations a considerable quantity of tube is left quite unprotected in this way. Of course, I shall be told that all these joints should be painted; but what I say is this, that if paint is good enough there, why all the argument, the paint is good enough anywhere!

Wallace J. L. Vandy.

London, S.E., *March 7th*, 1906.

Leyton Tramway Contract.

Your remarks, which I have read with interest, on this subject, are, in my opinion, not only fair, but very necessary, and contractors in general will, I am sure, appreciate the facts being made known through your columns.

Seeing that the contract for tramway feeders is now let, may I ask your readers what they thought of the specification for this part of the work?

I agree that it is creating a monopoly to state the name of the manufacturer of a given article, and it may interest the Council to know that materials of not only equal, but better quality, could be obtained cheaper than some that were specified.

Fair Play.

The Naval Engineer and Electricity.

I wish to take exception to a remark made by Mr. Smith in his article on the above, viz., that very little has been done by Mr. Wordingham since his appointment as electrical engineer to the Admiralty.

I have had many thousands of pounds worth of machinery, &c., for the Admiralty manufactured under my supervision, and I can assure Mr. Smith that the amount of good which has been wrought in the last two or three years is immeasurable.

Every detail, down to the very smallest, is now carefully thought out, and every provision made to prevent breakdown, the question of insulation receiving special attention. In fact, the Admiralty specifications now embody the very latest electrical practice.

Under the old *régime* some of the plant installed was simply iniquitous, and would not have been passed by any engineer of repute.

In the case of one particular apparatus, of which some hundreds have been fitted, a 3-H.P. motor is started under full load by means of a single-pole knife switch, and that of a most antiquated pattern.

Mr. Wordingham's policy is evidently to put in order, and bring up to date, the plant which has been handed over to electricity, before seeking pastures new. The conditions at sea, and especially on a man-of-war, are not ideal for electrical work, and there is no doubt that the policy of going slow is preferable to the reverse.

Maker.

An Engineer's Training.

The very interesting article on "The Naval Engineer and Electricity," by Mr. C. Alfred Smith, appearing in the last number of the Electrical Review, offers one the opportunity of further discussing such an important subject, with a view of attracting the attention of both the "Would-be Engineer" and those who are arranging and superintending the management of suitable courses for the successful training of such.

Mr. Smith points out "that it is quite as difficult, if not more so, to train a professional engineer than a doctor; therefore a longer period should be allowed for their training."

He goes on to say "that it is the fault of the present day; students are rushed through their engineering training in an insufficient length of time. Four years is not a sufficiently long period for college and works."

There is no doubt that a fault does exist in the present day, which accounts for the limited knowledge possessed by young engineers in that particular branch in which they have been trained for four years in a modern technical college.

Where does that fault lie? Is it that they rush through the course, or is it because they are not taught what they ought to be taught?

Let me describe my personal experience, and I will leave all those whom this may concern to judge for themselves where the fault exists.

I am a student in the fourth year's course of electrical engineering in a modern and well-known technical college, my ambition being to become an efficient electrical engineer in an electric light and power station or a tramway power station, and not an all-round engineer who knows everything and is worth hardly anything excepting in rare cases.

Out of 33 hours a week, 4 are devoted to mathematics, and only 8 hours to the electrical branch of engineering; these are 1 hour's lecture in electricity and electrical measuring instruments, 2 hours for electro-technics and 5 hours' practical experiments with electrical apparatus.

On the other hand, 9 hours are devoted to the mechanical engineering workshops, where no electrical tools of any form are in use.

Another 6 hours are occupied with machine drawing, not machine designing as it might have been with greater advantage for such an advanced stage, and 6 hours are almost if not quite absorbed in theoretical applied mechanics dealing with the strength and elasticity of materials, theory of mechanism, general theory of torsion, structures, struts, &c., &c.

Of course I am not of opinion that we learn too much, but we don't learn sufficient of what we want. What would be the use of bridge building, roof structures, masonry arches, and such like, to an electrical engineer? If an electrician is to know all this thoroughly, what should an architect, a mechanical and a civil engineer know?

In fact, mechanical and electrical engineering students work together and follow the same subjects every day. At the end of the training one goes out into the world as an electrical engineer and the other as a mechanical engineer, whilst neither is efficient in his particular branch.

In conclusion, I think four years might benefit us a great deal more if they were properly utilised.

Tyro.

Alternators in Parallel.

I have been interested in reading Mr. Stewart's letter in your issue of January 12th, under the above heading, but owing to my absence from England I could not write before.

I should like to make one suggestion to Mr. Stewart. May not the governing of his engines be too near perfection? I am inclined to think that a speed regulation of 5 per cent. from full to no load might give more satisfactory results than the 1½ per cent. mentioned. Suppose a case of absolutely perfect governing in which the speed does not vary at all from full to no load, then if all the dynamos are not fully loaded, there is nothing whatever to prevent the load changing from one machine to the other and back again all the time, since the load on the engine depends on the position of the governor, and not on the field excitation of the generators. This changing about of the load is not desirable, and may tend to throw the machines out of step. With much less sensitive governing, however, no machine can take too large a share of the load, as its speed is at once cut down.

If this suggestion lays itself open to the objection that the regulation of the sets is very much impaired, I would suggest that the field regulators of the machines be mechanically coupled while operating in parallel. It would, of course, be necessary to graduate the resistances so as to divide the load evenly, but once done this would always be right. The drop in speed on the engines would also have to be as nearly as possible the same.

F. A. B.

Overhead Equipment.

We have read with much interest your report of Mr. Tweedy's paper read before the Institution of Electrical Engineers on the "Construction and Maintenance of Overhead Equipment." We agree that it is highly desirable to reduce the cost wherever possible, but we think this end is not necessarily achieved by reducing the first cost, without due regard being had to the probable life of the materials used. Mr. Tweedy speaks of the shoddy work of some of the early American contractors, and we think he makes it clear that their methods still survive to some extent. Surely it is essential to avoid a "penny wise and pound foolish" policy? We are more particularly interested in his remarks on insulating bolts, and it seems to us, in respect of these, that it would be well worth the while of constructing engineers to try British-made goods as well as those made abroad, which may be cheap, but are clearly not reliable, and require renewal every few years. This deterioration is unquestionably a very serious matter, especially when it reaches such a point as is illustrated in fig. 1 on page 405, but it could not happen with Litholite bolts, for each one is carefully treated, before being coated with insulation, with a flexible, anti-corrosive paint which water cannot penetrate, and it is not possible for damp to creep up from the exposed end under the insulation. But these attacks come not only from without, but from within—from the insulation itself—for in these foreign bolts there are certain salts of ammonia and potassium in the insulation, the action of which tends to shorten the life of the bolt. This action is entirely prevented by the process referred to above.

We are forwarding under separate cover a bolt treated in the manner described, for your inspection.

Hunt & Hess.

London, *March 12th*, 1906.

Lost Opportunities.

In your issue of 2nd inst. you head a leaderette with the words quoted above. They are quite true when applied to the instances you mention, but, in my opinion, are not half strong enough; you ought to have headed your notes with the words "scorned, spurned, despised and rejected opportunities," for a man or a nation may *lose* an opportunity through no fault of his own, but this nation has despised and rejected its opportunities.

It reminds me of the story told of an Irishman who emigrated to America, and was asked by his new-found acquaintances what sort of country he had left, and this was his verdict. "Shure," said he, "it's a cursed counthry to live in, but a blessed counthry to die in, for while ye're livin'

in it iviry wan throws stones at ye, till ye're dead, and whin ye're dead, shure, they gathers thim all up, and builds a monyment over yez." And what else, pray, is it now with the movement for establishing a Perkin Research Fund, but a gathering up of the stones flung at the head of a great man, and a futile endeavour to build with them a monument to commemorate his achievement, while only in Germany, in the aniline industry, can be found the *only* monument at all commensurate with his discovery.

And what about Thwaite, with his struggle to prove the possibilities of power from blast furnace gases? And what about many another Englishman—aye, and Scotsman and Irishman, too—who has lived and died in a vain endeavour to rouse his fellow-countrymen to grasp the opportunities lying to their hands? Only those who have experienced it, can fully appreciate the irony of seeing the idea which one has endeavoured vainly to drive into the heads of his countrymen grasped by the foreigner, and instantly turned into a success. Truly, it gives one the feeling that Ruskin was right when he said that "Modern 'Education' for the most part signifies giving people the faculty of thinking wrong on every conceivable subject of importance to them."

Jan Gorach.

The Single-Phase Induction Motor.

In order not to incur a further justified rebuke from Mr. Fynn for criticising his theory before it was completed, I have waited to hear his Institution paper before replying to his last letter. The explanations given by him on that occasion were admirably clear, being made so by the use of diagrams. Now, that was my whole point, viz., that a circumstance such as the important effect of a small difference of phase between E T and E B, which does not appear in a verbal description, is instantly seen in its true bearings in a diagram or a properly constructed equation.

I think Mr. Fynn himself has overlooked a rather important point, probably owing to his disbelief in diagrams. He says: "I hold that the armature current can only be in phase with the E.M.F. (E T—E B) provided there is absolutely no self-induction in the armature axis."

Now I hold that at synchronism, no self-induction exists in the armature axis.

Interlinked with the armature circuit C C, are two fluxes: (1) The flux of mutual induction M between primary and secondary; (2) The secondary leakage flux M_2.

Since the two circuits C C and D D have an identical number of turns identically distributed, a given flux will induce an equal E.M.F. in either. Since we shall deal only with the ratios of such E.M.F.'s, we may omit the constants in the equations relating them to the fluxes by which they are generated, and write $E T = T N_1 M$, T being the rotor turns, N_1 the frequency, and M the flux of mutual induction between primary and secondary. Let N be the motor speed in cycles per second.

Let us trace the various effects of the leakage flux M_2.

1. It produces in C C an E.M.F. $E S = T N_1 M_2$ due to self-induction, or transformer action.

2. It produces in D D an E.M.F. of rotation $E R_1 = T N M_2$, opposite in phase to M_2.

3. $E R_1$ will give rise (neglecting the resistance of D D) to a current of such magnitude as to produce a flux capable of balancing $E R_1$ by its E.M.F. of statical induction.

This flux will clearly be $M_3 = \frac{N}{N_1} M_2$, and since it lags 90° behind $E R_1$, which is opposite in phase to M_2, it will be 90° out of phase with M_2.

4. M_3 will give rise to an E.M.F. of rotation $E B_1 = T N M_3$ in C C. $E B_1$ is in phase with M_3, and hence opposite in phase to E S, as may be seen more clearly by means of a diagram.

Substituting the value of M_3, we get $E B_1 = \left(\frac{N}{N_1}\right)^2 T N_1 M_2$,

or $E B_1 = \left(\frac{N}{N_1}\right)^2 E S$.

Hence, in the axis C C the flux M_2 produces a total E.M.F. $\left(1 - \left(\frac{N}{N_1}\right)\right) E S$, which vanishes at synchronism.

The effect of resistance, &c., in the circuit D D is to prevent the accurate vanishing of E S, but this does not seriously affect the action of the motor unless the resistance is excessive.

The above effect is absolutely vital to the action of the induction motor. It is the sole point which distinguishes it from the two-phase shunt motor shown in one of Mr. Fynn's early diagrams, a machine which, with all due deference, I submit is entirely useless. One may use neutralising coils to any extent to diminish the armature self-induction, yet this latter will always exceed the resistance to such an extent that the current will lag largely behind the E.M.F. producing it. In an induction motor at standstill the rotor circuits act as neutralising coils to the stator; yet the current lags largely, as all know.

It is true, as Mr. Fynn points out, that owing to a slight difference of phase between E T and E B, it might be possible for the armature current to be in phase with E B. This, however, can only occur at one particular speed, and such a motor would be very far from running at a nearly constant speed under varying load. In fact, one has not that automatic adjustment of the phase of the armature current which one gets in all motors, compensated and uncompensated, in which the field circuit is on the rotor.

I find, moreover, that in motors designed for variable speed by variation of the flux along D D, the free speed of the motor is always the speed at which E S vanishes. If however, we vary the E.M.F. E T ("variable voltage control") this is not so, and hence the former methods are preferable. This is almost obvious from the above. Of course, in the rotary field theory this effect is represented by a change of frequency in the leakage flux. I regret having been unable to make the calculation recommended by Mr. Fynn, in order to find how the no-load current is made up. I have, however, made the following simpler one.

Mr. Fynn gives us the following data:—

1. No-load current : mag. current : : 1·7 : 1.

2. The excess of the no-load current is due to the losses, consuming a current in phase with the applied E.M.F.

Assume the magnetising current wattless. We have now a right-angled triangle, the base being the magnetising current 1·0, the hypotenuse the no-load current 1·7 and the third side the "loss current."

The cosine of the angle between the watt component and the no-load current, *i.e.*, of the angle of lag of the no-load current behind its E.M.F., is $1 - \left(\frac{1}{1{\cdot}7}\right)^2 = {\cdot}64$, as may be seen from a diagram. I have never seen an uncompensated single-phase motor having a power-factor of this order on no-load and neither, I am sure, has anyone else, so I am afraid we must look elsewhere for an explanation of the magnitude of the no-load current.

I fear I did not make myself clear about the variable-speed motor. I succeeded in establishing clearly the principle of the motor last July, but was at that time unable to reduce it to a commercial form.

This letter is already too long, so I will defer the discussion of other interesting points in single-phase motor theory to another opportunity.

F. Creedy.

Ealing, *March 13th*, 1906.

Referring to the interesting article of Mr. Fynn on the above subject, I would say that the methods suggested by Mr. Fynn for regulating the speed of the single-phase induction motor (with the exception of those in which a phase transformer has been used) form part of a patent application dating from May, 1905, in which I have also shown how to calculate the auxiliary winding and how to obtain good commutation.

F. Punga.

Basle, *March 9th*, 1906.

Bribery or Blackmail?

It was with much interest I read your ethical editorial this week; but I am moved to comment upon the unwholesome way in which you discriminate by calling the same prostitution of honesty "corruptions" and "British

institutions" depending only on the relative popularity for distinction among cases in point.

As honest men, do you really intend to infer that usage, any amount of *usage*, or usage for any length of time, can transform into right that which is at root morally wrong?

By what process of right reasoning can you possibly arrive at the conclusion that a corruption is not a corruption if it be regarded as a "British institution?"

The corruption in question, by whatever appellative it be referred to, and upon whatever scale it be practised, is the same, whether Britain and all the world approve it or condemn it; and he who will give a "tip" will accept "backsheesh," whether he be a Turkish or British Customs official, or an electrical engineer.

As you point out, no clean-minded man can doubt that this wrong leaves its dirty stain on all concerned; both donor *and* recipient are alike contaminated.

I regret you qualify your condemnation, and make an exception where the shoe would possibly pinch yourselves. Does it not appear to you that the fact that "wages are regulated accordingly," is but a corruption, the fruit of corruption? Every man who gives a "tip" is but contributing to the spread and perpetuation of this moral disease which has permeated commercialism, and which you honourably seek to remedy. But I would fain see you clinch your appeal by thorough sincerity and sincere thoroughness. Why should you deny to others that umbrage you take to yourselves in bestowing "gifts" which blind to the true motive which should actuate service man to man? Presumably merely because "gifts" within their sphere of operations are not so popularly winked at as "British *institutions*." How ridiculous, too, for if that very simple expedient so effectually constitutes rectification, why need the Ministers you quote, and others harass themselves about legislation; simply call bribery and blackmail in all their appearances, small as well as great, "British institutions" and "this subject which every man would fain avoid" is disposed of.

Although "electricals" you should have an intelligent appreciation of how much is accomplished by the introduction of the thin end of a certain mechanical appliance, and consequently guard against making such unwarrantable inferences as, *e.g.*, that a "British institution" which breeds only insincerity, untruth, a detestable unmanly servility, a loathsome meek courtesy, and horrid hypocrisy, is not a corruption. Such is sheer jingoism and most unpalatable to

A True Patriot.

[We distinctly said that we were not concerned with tips to waiters and porters. Our correspondent seeks to draw us into a discussion on this subject; but we have enough to do with what directly concerns us, without digressing into general questions of social reform. Surely we have expressed our opinions emphatically enough on the immorality of bribery, whether in the shape of tips, presents, or any other form.—Eds. E.R.]

Shift Engineers' Holidays.

As one who is suffering the hardships of working 12-hour shifts during holidays, and the absence of any Bank Holidays, I should like to congratulate "Manager and Chief Engineer," who so ably defends the interests of his shift engineers.

It is a fact that, in a number of large provincial stations, shift engineers endure the hardships stated by your correspondent in March 2nd issue.

It is to be hoped "Chief Engineer's" letter will have caught the eye of a number of chiefs in the provinces, since the shift engineer appears to be the only person not considered, in spite of the fact that it is he who can effect economy in the generation costs, and thereby help to increase the salary of his chief.

Shift Engineer.

With reference to, and in support of, "Shift Engineer's" letter of March 2nd, I will take the opportunity of stating the working arrangements of the stations at which I am an engineer-in-charge:—

One eight-hour shift per day, including Saturday and Sunday.

In the event of one engineer falling ill, the chief assistant works the day shift, which is, of course, the shortest and most pleasant, the other two engineers work the evening and midnight shifts during the week, and from 2 p.m. Saturday to 9 a.m. Monday work at the rate of 12 hours per day.

We receive in summer 14 days holiday; for this we have to work about 10 weeks without a day off and 12-hour shifts *every* week end.

If an engineer leaves, the remaining two work the heavy and longest shifts and 12 hours per day during week ends until the post is filled.

We work the same hours at Christmas, New Year and all holidays.

Taking into consideration the long hours we work, the mental strain when on duty, which is never absent in any fair-sized power station, the qualifications necessary, and the low rate of wages, something ought to be done to bring this matter before all the Electricity Committees in the United Kingdom, when I feel sure that steps would be taken to see that we received a fair amount of time off and *some holiday* in the course of the year.

The majority of chief engineers will not, I fear, have this matter treated fairly, as they know that, by keeping the hours worked by their engineers to the highest limit (which amount practically verges on slavery in most stations), they are lowering the works costs at very little effort to themselves. But should this be done at the expense of a man's health?

I should very much like to get into communication with other charge engineers with a view of ascertaining whether, and how, this widespread grievance can be redressed.

Another Engineer-in-Charge.

The letter of "Shift Engineer" in your issue of 2nd inst. has opened up a subject of far-reaching importance to all in that position who are described by "Seven a Week" as "necessary evils," and we can only hope that our chiefs and chief assistants may take the matter as seriously as intended, and not after a casual glance at the correspondence, turn to some other page of the Review and forget the "man on the board."

At present our chiefs are too inclined to forget or overlook the fact that the engineers in charge are not off from noon on Saturday till Monday morning, nor are they off for Bank Holidays or other times like themselves, but are left in the station in charge of plant valued at many hundreds of thousands of pounds, for taking care of which they receive such munificent salaries, frequently less than the firemen or engine drivers.

Then when the holiday list is being prepared, the shift engineers often do not get much choice, but have to take the vacant dates left after the clerks have made their selection.

Surely it would be possible in all stations of 1,000 kw. up, to have a fourth man as described by "Manager and Chief Engineer," and so let the men who keep the station running have a rest every fourth week end, this man to be in charge of repairs, &c., in turn.

As motormen and conductors on our tramways get their day off in the fortnight, and often extra pay for Sunday, so should the shift man get some concession.

Apologising for occupying so much of your space, we can only hope to be able to improve the present condition of

Six of Us.

Solar Hypothesis.

Early in 1898 there appeared in the Electrical Review a most interesting series of articles entitled "An Electrical Hypothesis for the Solar and Planetary Systems," and signed with the *nom de plume* of "Delta." I was very much interested in these articles at the time, and often since then I have scanned the Review in hope of finding a further contribution from the same pen on the same subject.

Eight years are quite a long time considering the rapidity with which new discoveries are made in the domain of

science, and no doubt some of those new discoveries which are being daily made must have an influence either to confirm or disprove "Delta's" hypothesis. In 1898 radio-activity had only recently been discovered (Becquerel discovering the radio-activity of uranium in 1896) and such a highly radio-active substance as radium was quite beyond the dreams of the most riotous imagination, and so it has struck me that a few words from "Delta" on the effect which these discoveries have on his hypothesis might be of interest.

My own thoughts on the subject are scarcely worthy of being given, but in the hope that they may catch the eye of the gentleman mentioned, and that he may endeavour to resolve my doubts, I append them.

Briefly put, the sequence of ideas in my mind was as follows:—

(*a*) Helium is present in the solar spectrum.

(*b*) Radium gives off, or disintegrates atomically into, helium. Accordingly the presumption is that radium is present in the sun.

(*c*) Radium during its disintegration liberates such an immense amount of energy, that all other known methods of producing energy pale into insignificance beside it.

(*d*) If the action of radium is to throw off a stream of electrified particles, and if these pass through space without any great loss until they reach the atmospheric envelope, is that not to a certain extent corroborative of "Delta's" hypothesis? Not having made a close study of the subject, it would be unwise for me to speculate further, but I hope that the author of the "Electrical Hypothesis" may be tempted to give us his later thoughts on the subject, and I hope it is not too much to ask that he should drop his pen-name in doing so.

John D. Mackenzie.

Glasgow, *March 10th*, 1906.

[Walthamstow Cables.—We have been obliged to hold over until next week, owing to its late arrival, a lengthy communication relating to this matter, from Mr. J. H. Fooks Bale, of Walthamstow.—Eds. E.R.]

LEGAL.

The Cooper Patent "Anchor" Rail Joint Co., Ltd., *v.* The London County Council.

(*Concluded from page* 377.)

In the Chancery Division of the High Court on Thursday, March 8th, Mr. Justice Swinfen Eady delivered his reserved judgment in this action.

His Lordship said: The plaintiffs sue for the infringement of Letters Patent granted to Leonard Cooper, No. 23,578 of 1898, for "An improved joint for the rails of railways, tramways, and the like." The defendants deny the validity of this patent. If the patent is valid the defendants do not deny infringement. Previous to the year 1898 it was well known to engineers that the best and proper method of laying rails for tramways was different from that of laying rails for railways. In the case of railways the rails are laid above the surface of the ground and are much exposed to the action of heat and cold, and it is essential that provision should be made for the expansion and contraction of the metal caused by variations in temperature; the road has to be made elastic; there is some slight space left at the joint between the two rails; the joint is made by means of fishplates placed at the side of the rails and bolted together, and sometimes by soleplates placed beneath the rail similarly bolted; and the joints are placed between the sleepers, and when a train passes there is what may be called a wave of motion set up along the line. In the case of tramways, as the rails are not laid above the surface, but the top of the rails is level with the surface of the ground, the rails are protected by the surrounding soil from extremes of temperature, and the same expansion and contraction as in the case of railways do not take place. Accordingly the joints may be riveted instead of being bolted together, and may be made as rigid as possible. For some years previous to 1898 tramways were usually laid on concrete. It was, however, found in practice that however rigid at first the joint of the tramway rail was made, there was a great tendency for the rails to wear at the joints. A certain amount of "play" at the joints was soon apparent when the trams passed over them. Rain entered at these places and the passage of the trams caused the ends of the rails to move up and down and set up a pumping action whereby mud or mud and water were pumped out with a certain amount of concrete. This action gradually increased, and the concrete was washed away and a hole left, and in consequence a V-shaped depression of the rails was caused at this point. This in turn led the tram wheels to jump over this depression and the rails got battered and spread, and the wheels of the tram were also affected. Repairs and renewals were occasioned thereby. It is claimed that the result of the plaintiffs' invention as set forth in the specification, is to make an improved joint for tramway purposes, and obviate these inconveniences. By means of this invention the joint is made rigid, and is also anchored to the bed of concrete on which the tramway is laid, and thus all "play" is avoided, and the life of the road extended, and the repairs most materially reduced. The plaintiffs claim that according to the patented invention, the two ends of the rail are brought together in the usual way, and to the bottom flanges of the rail another length of rail of similar section inverted, is riveted. The lower or jointing piece is embedded in the concrete, while the upper portion or tram rail proper, rests on the surface of the concrete. The effect of this is that after the concrete has set the rails are kept rigid at the joints, there is no longer any movement or play at these points, and the pumping action and consequent wear and tear are obviated. An additional advantage is claimed in the case of the electric tramways, that the rigid joint keeps the metal surfaces together without oxidation and the electrical conductivity of the rail for the return current is preserved, and to such an extent that the rails can sometimes be safely used for this purpose without the intermediate copper bonding pieces commonly employed. The advantages to be derived from laying tramway rails in this manner, or according to this system, are not denied by the defendants, but they say that this is not the invention which Cooper specified and claimed, and even if it had been, would not have afforded subject matter for a valid patent. It is urged by the defendants that what Cooper claimed was an improved method of jointing rails, both for railways and tramways; that embedding the jointing piece in the concrete is only incidentally referred to; that the improved joint which Cooper claims was old, having been exactly described in Leslie's specification of 1872; and that no one can read the specification as describing an invention for adapting an old railway joint to tramways by an improved method of laying them. Mr. Swinburne, who was called for the plaintiffs, in his evidence in chief, said that there were two elements in the rigidity of the plaintiffs' joint. The first was having a joint, as a joint, as rigid and strong as possible, and the second element was embedding the jointing piece in concrete. In cross-examination, he said that there were two points in the patent, the first being the method of securing the two ends of the joint together, and the second being the anchoring down in the concrete. He was then pressed as to whether there was any novelty in the first point, and he said, "No. If you took Cooper's patent and put it on the Great Western Railway, there would be no novelty whatever," but that the novelty, and, indeed, the whole point of the patent was putting the old joint into the concrete. In my opinion the method of jointing rails specified and claimed by the plaintiffs was described by Leslie in 1872. Leslie's patent was for "an improved method of jointing rails," and he thus describes his invention:—

"This invention has particular reference to the jointing of flat-footed . . . . rails, and consists in bolting . . . . an inverted piece of the rail itself to the under side of the rails, so as to be connected by means of rivets passing through the holes in the top of the inverted rail and in the bottom flanges of the rails to be connected."

That is Leslie's verbatim, omitting intermediate words. This method of jointing rails he found to be a stronger form of fastening or jointing the ends of the rails than with the common fish plate, placed one on each side of the rails. Now, the plaintiffs' invention is for "an improved joint for the rails of railways, tramways and the like," and the patentee describes his invention as relating to the method of jointing rails for railways, tramways and the like. He says:—

"The two ends of the rails . . . . are brought together in the usual way, and to the bottom flanges a length of rail of a similar section . . . . is riveted."

But this is Leslie's invention exactly. Cooper then states that what he claims is—

"The combination of a length of metal of the same mass, or nearly so, as the rails to be joined, secured to the bottom flanges of the rails by bolts or rivets . . . . for the purpose of making a rigid joint."

In my opinion this is a clear and distinct claim to the same invention as Leslie described in 1872. In constructing a specification a patentee is to be presumed not to claim things which he must have known perfectly well were not new, but if upon a fair construction of the specification it is clear that he has claimed such old contrivance, the patent will be void on that ground. The law on this point is stated accurately in the present edition of Terrell on "Patents," by Mr. Courtney Terrell, on page 129. If I am right in this view there is an end of the plaintiffs' case. But the matter does not rest there. If, as was urged at the bar, Cooper's real claim is for an improved method of laying tram rails by using this joint theretofore only intended for railways, as distinguished from tramways, and adapting it to tramways, by embedding the jointing piece in the concrete upon which the tramways are laid, this is not, in my opinion, the invention described and claimed in the specification. The patentee does not state that the anchoring or fixing in the concrete is his invention, although he does refer to this advantage "when embedded in the concrete," and, moreover, the specification certainly does not distinguish between what was old and what was new, and the patent is open to objection on that ground. There is still a further difficulty in the plaintiffs' way. If the invention really is for the method of adapting Leslie's joint to tramways by embedding the jointing piece in concrete, is there sufficient novelty and invention in so doing to support a patent? Mr. John Robert Wignall was a witness for the plaintiff. He is an engineer with 20 years' tramway experience, and in 1897 was resident engineer of the Liverpool Corporation. He was cross-examined as to whether there was any invention in using Leslie's joint for tramway purposes—in laying the tram-rails on a continuous bed of concrete, and filling in the

concrete above the anchor plate or jointing piece. He said, as to this, that if he were told to use Leslie's joint in laying down a tramway, or to lay a tramway on Leslie's system, or according to his arrangement, he should lay the rails, first riveting the joints, then float in the concrete up to the level of the under surface of the top rail, and that he would have done so at once without any difficulty. This is really all that Cooper has done. The new use of Leslie's joint involves no ingenuity. There were no practical difficulties to overcome in the way of applying Leslie's joint to tramways. The obvious method of using Leslie's joint was to lay the tramway like all other tramways were then laid—namely, on a continuous bed of concrete, and where the anchor or jointing piece projects below the ordinary level of the bottom rail to embed it in the concrete. The patentee has, as Mr. Dugald Clerk said, simply laid Leslie's rail in concrete, the plain, obvious and only way of laying it for a tramway. What, in my judgment, Cooper really did, was to recognise—and he may have been the first to recognise—that Leslie's joint, although not in general use for railways, and, if made quite rigid, inapplicable to railways, was well adapted for use in tramways, as these had come to be universally laid in concrete. The method of so using it was obvious, and there was no novelty or ingenuity in the mode of using it as distinguished from novelty of purpose to which the Leslie joint was applied. In other words, any novelty was in the idea that Leslie's joint could be applied to a new purpose, and not in the mode of so applying it. This is not subject matter for a valid patent. (See Lane-Fox *v.* Kensington and Knightsbridge Electric Lighting Co., Law Reports, 1892.) The mode of fastening anything down by having projecting feet or any projecting portion wider at the base than above, and floating concrete over the projecting portion up to the level of the narrower portion, has long been in universal use for numberless purposes, and, amongst other purposes, has been described by Kincaid for fastening both chairs and continuous supports carrying tramway rails. For these reasons I am of opinion that the action fails, and must be dismissed with costs.

Swansea Corporation *v.* The National Telephone Co.

In the Court of Appeal on March 7th, before Lords Justices Vaughan-Williams, Stirling and Fletcher Moulton, the case of the Swansea Corporation *v.* The National Telephone Co. was mentioned. The appeal was by the National Telephone Co. against a judgment of Mr. Justice Buckley in the Chancery Division, holding that reasonable facilities ought to be given for intercommunication between the Corporation's telephone system and the National system. After considerable argument, the case was directed to stand over in order that an expert report might be obtained from Major Cardew, R.E., as to whether that which was asked for by the plaintiff Corporation was practicable.

Lord Justice Vaughan-Williams intimated that the report had now been received and would be filed. He desired to know whether counsel in the case wished to advance further arguments. If so, the Court would have to be constituted as formerly.

Mr. Danckwerts, K.C., stated that before he could answer his Lordship as to whether further arguments would be necessary, he should like to see the report.

It was arranged that counsel should see the report, after which they might apply to the Court if they desired to advance further arguments.

Bootle *v.* Liverpool Overhead Railway.

In an action against the Liverpool Overhead Railway Company heard in the Liverpool Court of Passage last week, two farmers, named Edward and William Bootle, were awarded respectively £29 and £12 5s. as damages sustained at Waterloo, near Liverpool. The plaintiff, Edward Bootle, was the owner of a wagon and two horses, which William Bootle was driving at the time of the accident, in respect of which the claim was made. The chain horse was frightened by the noise of an approaching electric car belonging to the defendant company, and swerved on to the tramway line. The result was, that the car collided with the chain horse, forcing it back five or six yards. The plaintiff, William Bootle, who was at the horse's head at the time of the accident, was found resting under the tram on the lifeguard. His injuries prevented him working for some time. Both horses were injured, and it was claimed that the accident was due to the negligence of the driver of the tramcar.—For the defence, evidence was given to show that the driver of the electric car slowed down and reversed the motors in order to avoid the collision, and actually pulled up the car in its own length. It was contended that the plaintiffs brought the accident upon themselves by allowing an unmanageable horse to go into a busy thoroughfare, where there was so much noisy traffic.

Johnson-Lundell Electric Traction Co. *v.* Milburn.

In the Court of Appeal, before Lords Justices Vaughan-Williams, Stirling and Moulton, on Monday, Mr. Beddall applied on behalf of the defendant in the case of the Johnson-Lundell Electric Traction Co., Ltd., *v.* Milburn, for leave to appeal from an order of Mr. Justice Bray, in Chambers, confirming the order of Master Chitty refusing to make an order for security for costs of the action.

Mr. Beddall stated that this was a test action, one of a number of actions brought by the company against shareholders who had refused to pay their calls, and the defendants had counterclaimed against the company for the return of the money they had paid for their shares on the ground of alleged false statements in the prospectus issued by the company, the total amount involved in the counterclaim being about £40,000.

Their Lordships granted the application.

Edinburgh Electricity Works Valuation.

Lords Low and Dundas gave judgment on 10th inst. in the appeal by the Edinburgh Parish Council against the valuation of the Edinburgh electric light undertaking. The *Edinburgh Evening News* says that the question was, what was to be the yearly rent or value of the electric light undertaking of the city. Two methods of ascertaining the amount had been proposed. That adopted by the Assessor and approved of by the magistrates was what was called the contractors' method, which consisted of taking as the yearly value a percentage of cost of the various lands and heritages constituted in the undertaking. The other method, for which the Parish Council contended, consisted in taking the actual amount of the receipts of the undertaking and deducting therefrom all the necessary expenditure, including interest on movable plant and floating capital, and the cost of collection and management, the difference between these two amounts representing either hypothetical rent or the free surplus which was available for rent on the one hand, and tenants' profits on the other. The total present valuation was £45,269, but the Parish Council maintained that it should be increased by adopting their method to £79,000. Lord Low, in a lengthy opinion, said there was a strong body of judicial opinion in favour of the method proposed by the Parish Council, but he by no means regarded the contractors' method as having been entirely negatived. The assessor contended that his method should be accepted on the grounds, first, that the electric light undertaking had not been in operation for a sufficiently long period to furnish a reliable basis for the revenue method, and, second, that the appellants could not complain because the revenue method produced a smaller value than the contractors' method. The former of these points appeared to his Lordship to be untenable, considering that the undertaking had been carried on for 10 years, and in regard to the second point, it was sufficient to say that, in his opinion, the operation properly worked out on the revenue method gave a much larger sum than that arrived at by the Assessor. Applying the revenue principle, his Lordship, after allowing certain deductions for depreciation and tenants' profits, brought out a valuation of £61,923, which, he thought, should be entered in the roll. Lord Dundas concurred.

Whipple *v.* Penpoll Tin Smelting Co., Ltd.

At the Liverpool Court of Passage last week, a claim to recover £49 14s. 11d. representing goods sold by the plaintiff, Cecil Robert Whipple, electrical engineer, Liverpool, to the defendants, the Penpoll Tin Smelting Co., Ltd., Bootle. The plaintiff's case was that he agreed to supply and fix at defendants' works an electric motor and friction hoist, the understanding being that it was required to hoist 12½ cwts. of ore at the rate of about 15 ft. per minute. There were two ways of making these hoists—one by what was called the single-purchase system and the other by means of snatch-blocks and pulleys or double-purchases. The latter system was that adopted, in the absence of any contract to the contrary. According to the *Liverpool Daily Post and Mercury*, the contention of the defendants was that the single-purchase system and not the snatch-block and pulley system should have been used. On the other hand, however, the plaintiff said that for slow lifting such as was in vogue at the defendants' works the snatch-block and pulley system was the proper form to be adopted; and, furthermore, the plaintiff submitted that the estimate of the defendants' contemplated such a system.

His Lordship, in the absence of any contract in writing to support the defendants' case, gave judgment in favour of the plaintiff for the amount claimed with costs.

[Other "Legal Intelligence" appears among our "Notes" on another page.]

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Jay" writes:—"Owing to the burning out of a feeder, about half the consumers in the town were left in darkness, and the other half in semi-darkness, in the busiest part of a Saturday evening, for something over 5 hours, and again on the following Monday evening for three-quarters of an hour. In view of the abnormal time taken in getting the supply on again, are the Corporation who own the undertaking liable for loss of business incurred by consumers who are tradesmen?

*** The question put by "Jay" depends upon the meaning which is to be put on Sec. 4 of the Schedule to the Electric Lighting (Clauses) Act, 1899, and the decisions thereunder. It is there provided that "in no case shall any penalty be inflicted in respect of any default, if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of the supply." In a case which was heard in Dublin some time ago (Sun Insurance Co. *v.* Dublin Corporation, Electrical Review, December 9th, 1899, p. 240), a cable which had been laid down proved defective, and the supply of energy broke down. This was held to be inevitable accident. The fact that there has been a great and unexpected demand for current will not, however, be regarded as inevitable accident (Marylebone Vestry *v.* Metropolitan Electric

Supply Co., *Journal of Gas Lighting*, May 1st, 1900, p. 1236). In the case put by "Jay," it is apprehended that the defence of "inevitable accident," would protect the Corporation, unless, of course, it can be shown that the burning out was due to negligence.

PARLIAMENTARY.

London County Council (General Powers) Bill.

The Supply of Electrical Fittings by Borough Councils.

The London County Council (General Powers) Bill came before the Court of Referees on Tuesday, when the question of the *locus* of certain of the petitioners against the measure was considered.

Mr. Moon, K.C., who appeared for the "Companies Supplying Electrical Energy in the Administrative County of London," said that his clients (the Charing Cross and West End Co., the City of London Co., the County of London Co., the London Electric Supply Co., and the South Metropolitan Electric Supply Co.) objected to Part 6 of the Bill, which conferred, not upon the L.C.C., but upon any Borough Council, power to supply electrical fittings to consumers or prospective consumers. The matter was one vitally affecting the companies, since it enabled the Councils to extend competition. It did not merely mean that the Council would be able to supply lamps, but that they would be able to supply to manufacturers and traders, motors and other electrical machinery and engines, such as were now coming largely into use, and which were now supplied by the companies on the hire-purchase system. As a precedent for granting the *locus*, counsel mentioned the Woolwich case, where the petitioners were allowed to be heard on the ground of new competition. Mr. Talbot (for the L.C.C.) contended that there was no new competition, and that the present time was not the time for a *locus* to be heard. The companies should wait until the borough councils took power to supply electrical energy and fittings.

The Court allowed a *locus* on Part 6 of the Bill.

Standing Orders.—On March 8th the Examiner of Standing Orders in the House of Lords passed the following amongst other Bills:—Buenos Ayres Grand National Tramways; Kent Electric Power; and Shropshire, Worcestershire and Staffordshire Electric Power.

North Metropolitan Tramway Bill.—This Bill, which provides for the dissolution and winding-up of the company, and the surrender of the lease to the L.C.C. was before a Select Committee of the House of Commons on Tuesday. The Bill was reported for third reading.

Grouping of Bills.—The General Committee on Railway and Canal Bills of the House of Commons have formed the following groups of Bills:—

(Group 1).—Hammersmith, City, and North-East London Railway; North-West London Railway; North-East London Railway; Romford and District Tramways.

(Group 2).—London Southern Tramways; London United Tramways; London County Council (Tramways and Improvements); Middlesex County Council (Tramways); Corporation of London (Blackfriars and other Bridges); Macclesfield and District Tramways.

(Group 4).—Baker Street and Waterloo Railway; Metropolitan District Railway; London and South-Western Railway; London Outer Circle Railway; Metropolitan Railway.

Folkestone, Sandgate and Hythe Tramway Bills.—Both Bills containing proposals for the construction of tramways in the above district have been found not to have complied with standing orders, and will have to be referred to the Standing Orders Committee for their decision as to whether they shall be allowed to go forward for the first reading.

West Riding Tramways Bill.—The Examiner of Standing Orders has found that there has been non-compliance with the rules of the House in regard to the above Bill, and it will be for the Standing Orders Committee to say whether the Bill shall be allowed to proceed.

Romford and District Tramways Bill.—The Standing Orders Committee of the House of Commons have decided that standing orders shall be dispensed with in the case of this Bill, and that the parties shall be allowed to proceed.

London Traffic Commission.—Sir H. Campbell-Bannerman has stated, in reply to a question, that while the Government do not propose to ignore the recommendations of the London Traffic Commission, they are not yet in a position to express an opinion on the findings of this body. No hope can be held out of legislation on the question during the present Session.

London Power Supply.—Sir H. Campbell-Bannerman has also stated that there is no intention of appointing a Royal Commission on this question. The *Times* says that the London Liberal members have decided that the London County Council Electric Supply Bill shall be supported by them on the motion for second reading, and the private companies' Electric Supply Bills opposed. The London Unionist members and a number of L.C.C. Moderates are anxious that the L.C.C. Bill, and all other Metropolitan Supply Bills, should be dealt with by the same Select Committee.

Second Readings.—On 8th inst. in the House of Lords the following Bills were read a second time:—Nottinghamshire and Derbyshire Tramways Bill, South Lancashire Tramways (Extension of Time) Bill, Wirral Railway (Extension of Time) Bill, and Preston, Chorley, and Horwich Tramways Bill.

On 14th inst. the Ascot District Gas (Electric Lighting) Bill was read a second time in the Commons.

In the House of Lords on March 12th the following Bills were read a second time:—County of Durham Electric Power Supply Bill, Newcastle-upon-Tyne Electric Supply Bill, Crediton Lighting and Power Bill, Southport and Lytham Tramroad (Extension of Time) Bill, Buenos Ayres Grand National Tramways Bill.

In the House of Commons on March 12th the Brixham Gas (Electric Lighting) Bill was read a second time.

BUSINESS NOTES.

Trade Announcements.—The London address of the Rhodes Electrical Manufacturing Co. is now Lancaster House, 102, Charing Cross Road, W.C., and it is under the management of Mr. H. Holt.

The London Telegraph Training College, which has been at Brixton for the past 14 years, is being removed to large premises at Earl's Court. The college is to be reopened on March 28th.

Mr. G. Braulik asks us to announce that Mr. H. N. Howlett, who has travelled for him for arc lamps and electricity meters is no longer representing him, and all communications should be addressed to the firm at 217-218, Upper Thames Street, E.C., until a new representative is appointed.

The Bigelow Co., of Newhaven, Conn., U.S.A., have acquired the American rights of the Hornsby Upright Water-Tube Boilers, and will manufacture these boilers for the United States.

Messrs. J. Hopkinson & Co., Ltd., of Huddersfield, have appointed Mr. Douglas Wells, M.I.E.E., of 10, Rue de la Pépiniere, Brussels, to be their sole agent in Belgium and Holland for their steam and water fittings, &c. Messrs. Eversheed & Vignoles, Ltd., of Chiswick, have also appointed Mr. Wells their sole agent in the countries named for their "Megger" and other measuring instruments.

Rights of Publication Transferred.—Mr. C. S. Vesey Brown asks us to announce that he has transferred the sole right of publication of the "Imperial Directory of Electric Lighting and Electric Traction" to the proprietors of "Garcke's Manual."

Australia.—*The Board of Trade Journal* says that a Customs notice has been issued to the effect that a drawback of duty will be allowed, subject to certain prescribed conditions, on the undermentioned imported materials used in the manufacture of articles within the Commonwealth, upon the exportation of such manufactured articles:—

Telephone parts used in the manufacture of telephones within the Commonwealth.

Book Notices.—"Fortschritte der Elektrotechnik." 1905. Part II. Edited by Dr. Karl Strecker. Berlin: Julius Springer. M. 7.

"Corso di Elettrotecnica." By G. Grassi. Vol. II. Motori, Convertitori, Accumulatori, &c. Torino: Casa Editrice Nazionale Roux e Viarengo. L. 16.

"*Proceedings* of the American Society of Civil Engineers." Vol. XXXII. No. 2, February, 1906. New York: The Society, 220, W. 57th Street.

"The Romance of Modern Electricity," by C. R. Gibson. Second edition. London: Seeley & Co.

"The Physical Review," Vol. XXII., No. 3. March, 1906. London and Lancaster, Pa.: The MacMillan Co.

"Wireless Telegraphy." By Gustav Eichhorn. London: Chas. Griffin & Co. Price 8s. 6d. net.

Burgess Hill.—The D.P. Battery Co. have installed a battery of 140 cells, LH type, for the Burgess Hill and District Electric Supply Co.

Dissolutions and Liquidations.—Electroid, Ltd.—Creditors must send particulars of claims, &c., to the liquidator (Mr. F. L. Jenkins, 17, Ironmonger Lane, E.C.) by March 30th.

Kamm's Zerograph Syndicate, Ltd.—Creditors must send particulars of their debts, &c., to the liquidator (Mr. H. Beevor Harvey, 13, Templeton Place, Earl's Court, S.W.) by April 4th.

River Plate and Brazil Roller Bearing Co., Ltd.—A meeting is to be held at 11, Queen Victoria Street, E.C., on April 10th to hear an account of the winding up from the liquidator (Mr. H. V. Thurgood).

Windsor and Eton Electric Light Co., Ltd.—A meeting is to be held at Salisbury House, E.C., on April 18th, to hear an account of the winding up from the liquidator (Mr. Wm. Sevenoaks).

The Buenos Ayres Electric Tramways Co.—A meeting is to be held at St. George's House, Eastcheap, E.C., on April 18th, to hear an account of the winding up from the liquidator (Mr. E. J. Summers).

Messrs. Dean & Tyler, electrical engineers and contractors, 45, High Street, Beckenham.—Messrs. A. Dean and H. W. Tyler have dissolved partnership. Mr. Tyler will continue the business under his own name, and will attend to debts.

Bankruptcy Proceedings.—J. S. Blackwell.—On March 7th, at the London Bankruptcy Court, an application for an order of discharge was made on behalf of James Stephen Blackwell, electrical engineer, who at the date of the receiving order in March, 1899, was trading in partnership with Wm. Arthur Charles, at 74 and 111, Church Gate, Leicester, and 22, Kennington Road, S.E., under the style of the Central Electrical and Engineering Co. Mr. E. L. Hough, Senior Official Receiver, reported that the trustee (Mr. Wm. Marsden Richards, of Leicester) had admitted

E

claims to the amount of £1,737; the firm's assets, valued by the debtors at £597 17s. 9d., had realised £268 10s., and a dividend of 1s. 1d. had been paid to the creditors. As offences the Official Receiver reported:—(1) Insufficiency of assets to pay 10s. in the £ to the creditors; (2) imperfect books; and (3) contributing to the bankruptcy by rash and hazardous speculation. The applicant attended from Leicester to be present, but did not attempt to contest the findings of the Official Receiver, and his Honour upheld the report. The discharge was granted subject to a further suspension of two years.

Thomas King, electrician and engineer, Maidstone,—Bankrupt appeared at the Maidstone Court last week for his public examination, and the hearing was adjourned to March 28th. The gross liabilities were £753, £554 being unsecured, and debtor put his assets at £984, stating that when realised there would be a surplus. Mr. Hawkings was appointed trustee.

Catalogues and Lists.—Messrs. Geipel & Lange, St. Thomas Street, S.E.—New list of Henrion "Graphitic" carbon brushes, also electric light carbons. The tramway motor brushes are reported to be very much in demand, and to have necessitated large extensions of the works.

The Electrical Co., Ltd., Shaftesbury Avenue, W.C.—New catalogue with many illustrations of electric cooking and heating apparatus. A great variety of domestic appliances are enumerated, from a cigar-lighter to a large roasting oven. Prices are given in every case.

Messrs. Alfred Herbert, Ltd., Coventry.—New catalogue (Section E5), giving full description, well illustrated, of their combination turret lathes and tool outfits for same, with tabulated dimensional data.

Portable Accumulators, Ltd., the manufacturers of the Pfluger Ignition Battery, have sent us a copy of an artistically designed and attractive show card, which will be found useful for display. A copy of the card will be sent to all *bona fide* traders and agents on receipt of a postcard addressed to the company's office at 210, Shaftesbury Avenue, W.C.

Messrs. Herbert Morris & Bastert, Ltd., Loughborough.—Illustrated catalogue describing their standard types of overhead travelling cranes.

Messrs. W. H. Bailey & Co., Ltd., Salford.—Catalogue No. 206, giving excellent half-tone and line diagrams showing the firm's specialities in boiler mountings, together with brief particulars of same, as well as tabulated information regarding prices.

Messrs. Mavor & Coulson, Ltd., Glasgow.—The March date card contains a diagram showing the output during 1905 of a "Pick-Quick" medium size electric coal-cutter.

The A.E.G. Foreign Department, 125, Charing Cross Road, W.C.—Various new publications as follows:—No. 2, particularising single, two and three-phase induction motors up to 5 H.P. output; No. 3, devoted to a description of petrol electric sets; No. E 3, detailing small and medium size motor-driven ventilators; No. 9, containing prices of incandescent lamps; No. E 9, describing their various arc lamp and accessory manufactures; No. 10, dealing with lamp-holders and lamp-holder accessories, ceiling roses, wall plugs, and other kindred things; and No. 12, giving information relating to flexible wires and insulating material. Two of the lists are very full publications of 40 and 96 pp. respectively, and all are illustrated and have a good deal of data set out in tabular form.

Messrs. J. H. Holmes & Co., Newcastle-on-Tyne.—Pamphlet No. 101, giving a list of country houses where they have carried out electrical installations. Some general descriptive notes on country house lighting, together with photographic views of some of the mansions in the list, are given.

A Sunbeam Supper.—The Sunbeam Co.'s workmen's annual supper was held at the Grainger Street Café, Newcastle, on 7th inst. Mr. T. J. Grainger, secretary, presided, supported by Mr. H. W. Edmundson, the assistant manager, and other members of the staff. The supper itself was a success, and this was followed by a programme of music and songs. The loyal toasts were duly honoured, but the principal toast was "The Sunbeam Lamp Co.," proposed in a few terse sentences by Mr. W. Young. Mr. Edmundson, in responding, remarked upon the change which had been wrought in our industrial conditions, that the operatives were in many cases nowadays counted simply as parts of the machine; but while that might be true generally, he had the satisfaction of knowing that their own relations were of a different and happier order, and if the good understanding continued, it would be a happy augury for their future success. Mr. Grainger added his observations, and referred to competition, which they could only meet by co-operation on the part of the workmen with those who held the administrative and executive functions; he was not afraid of the competition of the foreign lamp, or even foreign bulbs, as witness the fact that they were supplying themselves with their own bulbs, thus making the lamp entirely at Gateshead; what unfortunately they had to face was an absurd competition among English manufacturers. Healthy competition he welcomed, but a ruinous cutting of prices did none of them any good; but, in spite of this, they, by making a good lamp, held their own, and their business continued to increase.

Germany.—The Berliner Elektromobil Droschken Gesellschaft is increasing its capital to £75,000 to enlarge the number of electrical cabs in service in Berlin.

Tramrail Welding.—We are informed that Messrs. Thermit, Ltd., have issued a writ against "Weldite, Ltd.," for an injunction restraining that company from infringing, by means of the substance called "Weldite," the Thermit patent processes relating to the welding of rails, &c.

For Sale.—The Metropolitan Asylums Board is offering certain second-hand electrical and other engineering plant for sale, as announced in our advertisement pages to-day.

Plant for Bombay.—Messrs. Witting, Eborall and Co., Ltd., have supplied to Messrs. Greaves, Cotton & Co., of Bombay, India, the equipment for five cotton spinning mills, including the generating plant and switchboards, together with all lighting fittings and accessories. They are further shipping a considerable quantity of material to the above firm in connection with the same class of work.

Motor-Car Exhibition.—Nearly 300 firms will be exhibiting at Cordingley's Motor-Car Exhibition at the Agricultural Hall, London, which opens on the 24th inst.

Horsfall Destructors.—The Horsfall Destructor Co., Ltd., have recently signed a contract for the supply of a 4-cell Horsfall patent destructor for the Municipal Commissioners of Singapore, Straits Settlements. This destructor, which will be of the latest type, is an extension to an existing plant erected many years ago in the City of Singapore. The Horsfall Co. have also secured the contract for a 4-cell destructor with two Babcock and Wilcox boilers, buildings and chimney complete, for the Burgh of Dunoon, the well-known seaside resort on the Clyde.

Belgium.—Those firms who are interested in trade with Belgium will be well advised if they study the following notes that have been received by us from a correspondent in that country:—"Contracts in Belgium are with State Railways, G.P.O., Government Departments, and most Corporations in nearly every case. It is necessary to appoint an agent living and paying taxes in the country. Nobody can come over and stop at an hotel and do the business. The agent may be of any nationality, but he must satisfy the Administration that he is an engineer and sufficiently strong financially. The agent is solely responsible for the contract, fines, &c., even to the extent of his furniture and property. The exact expression is, 'Je m'engage par le presente sur mes biens, meubles et immeubles à effectuer,' &c. The caution money is usually 10 per cent. of the contract or approximately so, and receives 3 per cent. interest. Firms having an authorised agent or their own office in Belgium, usually only have to pay the caution money a few days after they receive the order; this clause varies in different departments. In some cases, even with a resident agent, half the caution money is required when tendering on a stamped Belgian Government form. All tenders must be on stamped forms. This information will save disappointment to many English electrical engineers who often cannot understand why they have received no replies to a tender. The Government do not advise the parties tendering. If you write to the Administration they simply reply, 'Votre soumission est irregulier.'"

Automobile Exhibitions at Olympia.—The *Times* says that in future commercial vehicles will not be included in the November exhibitions of the Society of Motor Manufacturers and Traders, but a distinct exhibition for commercial vehicles will be held in the spring of each year. This is due to complaints of inadequate accommodation and increasing membership of the society.

LIGHTING and POWER NOTES.

Australia.—Sydney.—The E.L. Committee has decided to recommend the City Council to carry out the wiring of consumers' premises, the cost being repaid by instalments, and also to allocate £2,000 for the purchase of motors for hiring out, with optional terms of purchase.

Bath.—The assessment of the electricity undertaking is to be raised from £1,200 to £1,800, and as this appears to be excessive, the E.L. Committee has resolved to call in a valuer at a fee of 50 guineas.

Boston.—The B. of T. has informed the T.C. that it is of opinion that the application of the National Provincial Electricity Corporation for a prov. order to supply electricity should be granted, the company agreeing to the insertion in the order of a provision enabling the municipality to purchase the undertaking after 21 years at a valuation as a going concern. The Council has unanimously decided to consent to the company's application.

Bradford.—The controversy concerning the annual accounts of the Electricity Committee, which has extended over some weeks, and has arisen out of an assault by the elective auditors on the official figures, continues with unabated vigour. The auditors now allege that the stock of motors and arc lamps has been valued at about £8,000 more than it is worth, and that the alleged profit of £8,709 has been arrived at only by that means, and by keeping the amount allowed for depreciation at an unreasonably low figure. This matter is to occupy the attention of the next meeting of the Finance and General Purposes Committee.

Bristol.—The City Council has adopted the recommendation of its Electrical Committee to approach the B. of T. with a view to obtaining an order providing that the Somerset and District Electric Power Act, 1903, shall cease to be operative within the city and county.

trustee (Mr. Wm. Marsden Richards, of Leicester) had admitted

E

Cannock.—The U.D.C. has now arranged terms, subject to the sanction of the B. of T., upon which the prov. order will be transferred to the Shropshire and Worcestershire Electric Power Co. The company is to pay the Council £550 for the transfer, plus £25, for the Council supporting the company's Bill, and is to supply electricity for lighting purposes at 4½d. per unit, at 1½d. for power purposes, and ¾d. to the Council for use at the Sewage Farm. Arrangements have also been made so that within certain periods extended areas will be lighted.

Cheadle and Gatley.—The Stockport T.C. has decided to take over the Cheadle and Gatley E.L. order.

Cheltenham.—The T.C. has decided to adopt the following revised scale of charges for energy:—Lighting, first 125 hours per quarter, 5½d. per unit; next 125 hours, 4d.; beyond, 2d. For motors a flat rate of 2d. per unit has been adopted.

Continental Notes.—Italy.—La Societa Elettrica Morosticense, of Morostica, has decided to undertake the electric lighting of that town.

A concession has just been granted by the authorities of Genoa for the erection of a hydro-electric plant on the River Ponzema at Campoligure in the generation of electrical energy for lighting and power purposes.

Holland.—Contracts have just been let for the establishment of a scheme for the electric lighting of Arnheim.

Croydon.—The B.C. has received a request from the County of London Electric Supply Co. to supply energy in bulk for distribution at Purley and Sanderstead, outside the borough. This is to meet the immediate demand, pending the completion of the company's works. The Council decided to comply, subject to suitable terms and conditions.

Fareham.—The U.D.C. has decided to reduce the price of energy for lighting from 7d. to 6d. per unit, from Lady Day.

Gomersal.—The U.D.C. on March 8th received from the B. of T. a letter stating, with respect to the Gomersal E.L. order, that before deciding whether it would dispense with the Council's consent, it wished to know whether the latter desired to be heard in reference to the application for a prov. order. The Council has replied in the negative.

Glasgow.—A large demand for electricity having arisen in the Springburn district, the engineer has recommended that it would be preferable to erect a sub-station for that district. The Electricity Sub-Committee has agreed to the engineer's suggestion.

Gosport.—The U.D.C. has decided to write to the tramways company and ask when energy will be available for lighting, and at what price per unit it will be supplied.

Hanley.—In answer to an inquiry from Fenton U.D.C. as to what terms the T.C. would be prepared to supply energy to the district, the Corporation has offered similar terms for E.L. and power to those charged in Hanley, in the event of the Council supplying the district.

Henley-on-Thames.—The T.C. has given its consent to the application of the Mutual Electricity Supply Co. for a prov. order for E.L.

Ilfracombe.—The progress of the electric light as an illuminant, at the expense of gas, is being demonstrated at Ilfracombe. At the annual meeting of the Gas Co. on Wednesday last, a shareholder (the town clerk of the town) pessimistically pointed out that since 1903 the private consumption of gas had fallen from 42,940,800 cb. ft. to 40,342,500, and the public consumption had decreased from 4,361,000 to 4,212,000 cb. ft., representing a loss in revenue of £513. He added that the stock and loan account had increased from £36,000 to £50,000, and inquired whether the directors had the same confidence in the undertaking now as in 1903. The chairman replied in the affirmative, but said that during the past two or three years the company had had to compete with an electric light company, which had secured some of its best customers.

Kearsley.—It has been reported to the U.D.C. that the B. of T. considers that the proposed arrangement to transfer the E.L. order to Messrs. Foote & Milne would be *ultra vires*. The negotiations will consequently end.

Leyton.—On March 9th a L.G.B. inquiry was held relative to the application of the U.D.C. for a loan of £21,100 for the extension of the E.L. station, and the provision of additional plant to supply power for working the tramways. There was no opposition.

London.—Hammersmith.—The B.C. has resolved to take up a loan of £15,210 for extending the electric lighting system.

L.C.C.—The Council has decided to lend £10,000 to the Stepney B.C. for the extension of the power house.

Macclesfield.—The T.C. on March 8th decided, by 26 votes to 15, not to proceed further with the electricity scheme which has been before the Council for many months. In committee, a similar motion was brought forward, but the voting was equal, and the Mayor, who is the chairman of the Electricity Committee, declined to give a casting vote. The proposed scheme entailed an outlay of £16,000, but at a recent L.G.B. inquiry into an application for a loan of that amount, the Inspector characterised the scheme as a skeleton one, saying that £20,000 at least should be the initial expenditure. He also stated that it was plain that the whole thing was speculative, and that in view of another big expenditure in prospect, the town would be very unwise to embark on such a scheme. There is a strong opinion, led by Alderman Colonel Brocklehurst, M.P., that it would be better to let a private company undertake the supply.

The Maldens and Coombe.—The U.D.C. has resolved to employ an electrical engineer to inspect the district and draw up a report as to the best means of providing electric light for the district, at a fee of £31 10s. The Council's prov. order expires in August.

Mid-Durham.—The promoters of the Mid-Durham E.L. order have requested the B. of T. to dispense with the consent of the Brandon U.D.C. and the Durham C.C. to the application.

Newcastle-on-Tyne.—In September last, the Watch Committee recommended that certain streets should be lighted by electricity supplied from the tramways power station; the Council deferred its consideration of the report, and directed the Committee to approach the gas company with a view of seeing whether it would amend the terms for lighting the streets by gas. As a result of the correspondence the Committee has decided to adhere to its recommendation of September, which was that 180 lamps be fitted to the tramway poles in some of the leading thoroughfares. These, at an average of 700 c.p. each, would give a total illuminating power of 126,000 c.p., and would cost £1,980 per annum, including the amount required annually for the redemption of the estimated expenditure (£4,500) on lamps, fittings, &c. The reduction in the cost of the existing 200 lamps would under the new arrangement amount to £900 per annum. To light the streets in the scheme with gas would cost £841, the lamps required would be 206 and the illuminating power would be 61,800 c.p.

At the T.C. meeting on the 7th inst. an amendment was moved that the matter be again referred back, but the Mayor remarked that provision had been made at the power station for this lighting, and £12,000 to £14,000 had been expended. The Committee's recommendation was then adopted.

New Zealand.—Te Aroha.—The B.C. has decided to ask the ratepayers' sanction, before borrowing a further £1,000 to complete the E.L. scheme.

New Plymouth.—The electric lighting of the town was formally inaugurated by the Mayor and Mayoress a few weeks ago. The scheme has been carried out at a cost of about £14,000, the Brush Co. being the contractors for the plant and Messrs. Steuart & Fenn the consulting engineers. The prices to be charged by the Council are, for lighting, 8d. per unit with 25 per cent. discount, and for power, 3d. with 1d. discount for prompt settlements.

Wellington.—From the local Press we gather that the City Council is inclined to dispute the contention of the E.L. and Power Co. that the company has the sole right to provide E.L. and power supply to the city. A recommendation of the Tramways Committee has been before the City Council in regard to supplying two firms with energy for lighting purposes, and if adopted the company will have an opportunity of challenging the Council's right to supply. A loan of £25,000 has been authorised by the ratepayers for public lighting, but the Mayor has stated that the Council will have to ask for a larger sum.

Waipori.—The Waipori hydro-electric scheme is complete as far as the penstock, and work is now proceeding with the pipe line. The fluming is constructed of red birch 6 ft. wide × 4 ft. high, and has a total length of 1½ miles with a fall of 8 ft. per mile. Five tunnels have been cut ranging from 72 ft. to 290 ft. in length; the length of the fall of the pipes from the penstock to the power house is 1,825 ft., and the fall, 674 ft. The erection of the power house has been commenced, and the plant for the first two sets has arrived out, each consisting of double Pelton wheels direct connected to 1,000-kw. generators

Auckland.—Mr. Goodman, the electrical engineer acting for Messrs. Noyes Bros., has reported to the C.C. that he estimates the cost of an E.L. installation for the city at about £20,000.

Waihi.—From a New Zealand paper we understand that the Waihi G.M. Co. has asked leave of the Government to utilise the energy of the Horahora Rapids for the generation of electrical energy. The company offers to expend £70,000 to develop about 4,000 h.p., with the necessary transmission line to Waihi, and to complete the work in 18 months, the Government to receive from the company an option to take over the whole installation at any time at an advance of 4 per cent. per annum on its cost at the time of construction. A minimum carriage over the railway of 20,000 tons of coal per annum for five years, or until the Government takes over the scheme, is guaranteed. In the event of the Government deciding to take over the plant, the company desires a supply of energy at the rate of £6,000 per annum for a maximum of 2,000 h.p.

Queenborough.—The B. of T. has informed the T.C. that it proposes to sanction the scheme for electric lighting under the Isle of Sheppey and District E.L. order, 1903, promoted by the local electric lighting company.

Sheffield.—A Special Committee has recommended the T.C. to retain Sir William Preece, at a fee not exceeding £105, to advise it as to the cost of production of energy at the E.L. and tramway power stations, and as to the utilisation of waste steam available at the refuse destructors for the generation of ectricity.

South America.—The Chascomus Municipality has accepted the tender of the Cia. Obras Publicas del Rio de la Plata for the electric lighting of the town at the following prices:—8-ampere lamps and 4-ampere lamps, all night, $27.5 and $20.3 per month respectively.

Stafford.—Owing to the increase in the demand for electricity, it has been decided by the Council to purchase additional land at a cost of £1,750 for extensions when necessary.

Sunderland.—A L.G.B. inquiry was held on the 7th inst. into the application of the Corporation for sanction to borrow £18,000 for E.L. purposes. About one-third of the loan is for building purposes. The output last year was 4,772,913 units; the estimated output for this year is over six millions.

The Electricity and Lighting Committee of the T.C. has recommended the rejection of the offer of the County of Durham Electric Power Supply Co. to lease for 21 years the Corporation's electricity stations at a rental of £12,000 per annum.

Wellington.—The U.D.C. has decided to sell its provisional order for the supply of electric light to the Shropshire, Worcestershire and Staffordshire Electric Power Co. on condition that the company pays the Council the sum of £100 towards the cost incurred in obtaining the order. The company is to lay mains in the compulsory area within 12 months, and to agree to terms as to further extension. The Council is to give a general consent to the company, and to the erection of overhead mains to supply energy for lighting purposes at a price not exceeding 5d. per unit until the demand reaches 250,000 units, when the maximum charge shall be 4½d.; the company to supply energy for power at 1½d. per unit, and energy for street lighting on a sliding scale of 2·6d. to 1d.

West Bromwich.—The T.C. has resolved to expend £500 on mains extensions.

Wolverhampton.—The Electricity Committee proposes to ask the sanction of the L.G.B. to borrow two sums of £10,000 and £2,000 for the extension of mains and for meters and indicators respectively.

TRAMWAY and RAILWAY NOTES.

Ayr.—The T.C. is considering a proposed extension of the tramway system to Hawkhill district and Whitletts, amounting to 1 mile 5 furlongs.

Birkenhead.—In the Chancery Division on 8th inst. Mr. Justice Warrington gave judgment in the case of "The Attorney-General *v.* the Mersey Railway Co." The action was instituted by the Attorney-General at the relation of the Corporation of Birkenhead, who asked for an injunction to restrain the Mersey Railway Co. from running motor-omnibuses in connection with their railway system in the borough of Birkenhead, whereby, it was alleged, they were acting in excess of their statutory powers. An injunction was granted, but it was stayed for a fortnight pending notice of appeal.

Cheriton.—The U.D.C. has decided to oppose the schemes for constructing electric tramways through the district from Folkestone and Hythe.

Chicago (U.S.A.).—The report by Mr. James Dalrymple, general manager of the Glasgow Corporation tramways, on the proposed municipalisation of the Chicago tramways, was issued on Monday, being published simultaneously in Glasgow and Chicago. The document, an exceedingly lengthy one, sets forth at the outset that Mr. Dalrymple understood the position to be that Mayor Dunne was elected to that position by the citizens of Chicago on a distinct issue, the immediate municipalisation of the street railways of that city.

Regarding the present condition of the street railway systems of Chicago, he considered that the citizens were fully warranted in demanding an immediate change, so that they might have the travelling facilities that were enjoyed by the citizens of every other city in the United States. After referring to the difficulty in connection with acquiring the different franchises which had been granted to the street railway companies, Mr. Dalrymple remarked that he could not refrain from expressing his strong conviction that a serious attempt should be made on the part of the municipality and the street railway companies to arrive at a reasonable settlement. The present companies should be merged into one, so that the whole might be operated as one complete system. There must be one fare, and no central loops. The use of trailer cars should be discontinued. The present equipment would require in a great measure to be thrown on the scrap heap, the whole work of reconstruction being carried out in the sight and to the satisfaction of the city officers. The new operating company might be allowed a fixed time in which to have the whole system put into complete order, and afterwards have a franchise for, say, 20 years, the municipality having the right, say, every five years to take possession on stated terms. A percentage of the gross annual earnings should be handed over to the city treasury, to be used for specific purposes, such as the upkeep of the streets; full and detailed statements of all income and expenditure, both on account of capital and revenue, should be produced annually by the operating company to the city officers. Under good, sound, economical management, the street railway system of Chicago was destined to be not only the largest, but the first in the world.

Assuming that the present companies were unwilling to meet the Corporation on anything like reasonable terms, he would say that they should undoubtedly start the municipal system on each line as the franchise expired. He should be very sorry, however, were they forced to take that step, as, speaking generally, he should say from his knowledge and experience of what it meant to operate a municipal street railway system, that the municipalities of the United States were not yet quite ready to undertake that work successfully. He would recommend that the street railway department be managed by a small committee of the City Council, to be chosen irrespective of politics, and that the whole internal management be placed under one permanent officer. No other system should be thought of at the present time than the overhead trolley. If properly constructed it was not unsightly, it was not dangerous, it was the most reliable, and it was the most economical both to construct and maintain. To install the underground conduit in any part of Chicago would for various reasons be a scandalous waste of money. In regard to the production of power, it should not be necessary for them at the outset to erect a power station, but when the whole system was in operation they should certainly have one central high-tension generating station, with sub-stations. Meanwhile they should purchase their power. In regard to the fares, it was unlikely that the citizens would care to change from the uniform fare, with transfers, to the European system. They could not issue transfers if they adopted the graded system of fares. In conclusion, Mr. Dalrymple said that if the Council should finally decide that there was no other course open than gradually to municipalise the street railway system, he would give them every assistance in his power in regard to the organisation of the various departments. Mayor Dunne cabled for a fuller report, and Mr. Dalrymple outlined a scheme for a municipal tramway service in considerable detail.

Continental Notes.—Italy.—The Italian Royal Commission appointed to consider the question of electric traction on the State Railway, has recently published a report as to the cost of working on the lines established at Valtellina and Varese. Whilst in 1897 with steam, the cost per train-kilometre was 2,706 lire, for a similar period, 1903-4, with electrical working, the cost was 1,943 lire, a reduction of about 28 per cent. in working costs, notwithstanding the fact that the average length of trains drawn by the steam motors consisted of 13 axles, against an average of 18 axles for the electric trains.

In looking into the comparative advantages of the three-phase system with overhead trolley wires, and of the third-rail system, it is pointed out that the cost of the former is about half that of the other. There is every reason to suppose that the result of this report will be the immediate adoption of electric traction over the length of lines between Lecco-Milan and Usmate-Bergamo, the supply for both of which can be taken from the Morbegno power house.—*L'Elettricita.*

East Ham.—The T.C. has received a letter from the B. of T. consenting to the proposed laying of a double line of tramways in lieu of the single in Aldersbrook Road, and sanctioning the borrowing of a sum of £1,050 for the purpose.

Folkestone.—The T.C. has adopted an agreement consenting to the system of tramways to Cheriton, Sandgate and Hythe, for which the National Electric Construction Co. is seeking Parliamentary powers. The company is to pay the Corporation £16,200 immediately for certain considerations.

Glasgow.—A switchback electric railway under the Clyde will be ready for passengers shortly. The tunnel was originally constructed for foot passengers. It was entered at both ends by a long flight of stairs. The absence of elevators and the keen competition of the ferries acted as a deterrent to its popularity. The company owning it has now transformed the tunnel into a railway, a car conveying the passengers across.

The Tramways Committee has decided to proceed at once with the extensions from Castle Street along Garngad Road, and from Tollcross eastwards, authorised by the Glasgow Corporation Tramways Act of 1905, the work to be carried out by the staff of the department.

Hyde.—The Hyde T.C. has this week sanctioned a scheme proposed by the Joint Tramways Board of Stalybridge, Hyde, Dukinfield and Mossley for laying down tramlines along Newton Street, from George Street to Manchester Road, also from the present tramlines of the Joint Board in Market Place to those of the Oldham, Ashton and Hyde Co. in the same thoroughfare. In each case the distance is within 50 yards, but the double connection will supply a convenience that has long been desired.

Lancaster.—The T.C. on March 8th decided by the casting vote of the Mayor not to lease the electric tramways to Messrs. Kershaw & Co., of Birmingham. The whole question has been referred back to the Tramways Committee, to take expert opinion if thought desirable.

London.—Baker Street and Waterloo Railway.—On Saturday last this new tube railway was duly opened to public traffic. The smooth running of the trains excited general comment, and the line was freely patronised, the whole organisation working without a hitch.

Metropolitan District Railway.—Another breakdown took place on the District Railway on Monday evening, two axles

breaking, near Hammersmith Station. Considerable delay to traffic ensued. On the same day a breakdown occurred near Earl's Court.

L.C.C.—The Highways Committee reported that the agreement with the South London Electric Supply Corporation for the supply of power would expire on May 15th. The first portion of Greenwich station would be completed in the next few weeks, but the process of transferring the load from the temporary stations to the permanent station would occupy some time. In these circumstances it seemed desirable to extend the agreement with the South London Co. until the supply from Loughborough Junction could be entirely dispensed with. The price paid at present was 1·4d. per unit for electrical energy generated. The company had expressed its readiness to enter into a fresh agreement providing for a reduced supply of power upon a sliding scale of charges based upon the output, the minimum price being ·75d. per unit and the maximum price 1·25d. per unit. The agreement would be terminable upon one month's notice on either side, and the Council would pay a rental at the rate of £200 per annum for the retention of its plant on the company's land.

An expenditure of £10,000 is proposed for the acquisition of a site for a sub-station near Holborn.

Manchester.—The application of the Manchester Corporation tramway workers for extra pay for Sunday labour, which has been backed up by the threat of a possible strike, was considered at a meeting of the Tramways Committee on Tuesday. After a lengthy discussion, a reply to the men's demand was formulated. In this the Committee justifies its attitude of opposition, and recapitulates the concessions made to the employés since the city tramways were taken over by the Corporation, in respect of wages, hours of labour and general working conditions. These concessions (apart from the one recently granted as to payment for overtime) are in the aggregate costing the department about £50,000 per annum. The further concession now demanded, the Committee says, would, if granted, cost a further sum of £6,000 per annum, and the Tramways Committee has come to the conclusion that it cannot, in justice to the ratepayers, accede to the demand. Apart from the financial aspect of the case, the Committee objects to any discrimination in tramway traffic work between Sunday labour and ordinary week-day labour. The wages paid and the general working conditions in the Manchester Tramways Department are equal to, if not better than, in any other municipal tramway system in the kingdom. The Committee, however, is willing that the dispute should be referred to an arbitrator to be appointed by the Board of Trade.

Newcastle-on-Tyne.—The B. of T. has declined to sanction the running of cars on the Fisher Hill route owing to the danger on that part of the route. The line has been constructed at considerable expense. The Tramways Committee has decided to open up negotiations with the Tyneside Tramways Co., who have running powers over the section, to see if some arrangement can be made to overcome the difficulty at the place indicated.

New Zealand.—Christchurch.—A meeting of the ratepayers was held recently to consider the proposal of the Tramway Board to raise an additional loan of £100,000 to carry out various extensions to the system. A resolution approving of the scheme was put and carried.

Wellington.—The Corporation is now constructing some new car bodies in its own shops, and we gather that machinery has been ordered and preparations made to enable the Corporation to do all its car building in future.

The result of the nine months' working, ended December 31st last, is a net profit of £7,262, after £9,071 has been set aside to interest and £2,059 to sinking fund.

Auckland.—Owing to subsidences occurring to the track in Queen Street, it has been found expedient to draw up a scheme for relaying it. The manager to the company has forwarded plans to the C.C., according to which it is proposed to adopt pile construction and to put down concrete with scoria blocks at the surface, in lieu of wood and asphalt, as used at present.

North Ayrshire.—The failure of the Road Board of the County Council to come to terms with the promoters of the proposed scheme of tramways has resulted in the Council passing a resolution expressing dissatisfaction with the Board because it did not seek the assistance of the Tramway Committee.

Poole.—The T.C. has received from the B. of T. sanction to raise a loan of £29,063 for the construction of the Parkstone Extension Tramway.

A long discussion took place at the meeting of the T.C. on March 6th relative to a recommendation to accept the tender of the Brush Electrical Engineering Co., Ltd., at £26,168 for the construction of the electric tramways. The British Electric Equipment Co., Ltd., tendered at £810 less, and Mr. F. S. Grogan, a representative of the firm who attended the meeting, asked the Council to explain why his firm's tender was refused. The Council discussed the whole report of the Committee *in camera*, and eventually adopted the recommendation of the Committee.

South Shields.—At the meeting of the T.C. on the 7th inst., the Council agreed to withdraw its petition against the North and South Shields Electric Railway Bill on the promoters undertaking to reimburse the Corporation the full amount paid by it for the purchase of the land in Mile End Road, with 4 per cent. interest on the £6,000 paid by the Corporation for the land until it is acquired by the promoters.

The first electric car was run over the Corporation tramways on Friday last

TELEGRAPH and TELEPHONE NOTES.

Australia.—The Postmaster-General of the Commonwealth has decided to introduce the toll or measured rate system of payment in connection with the telephone services. The subscribers will be given a much better service than that now provided; modern switchboards, with the latest fittings, are to be installed in the Melbourne and Sydney General Post Offices, and subscribers who pay toll rates will be connected with these systems. Subscribers who pay fixed rates will have to put up with the present defective services. The Postmaster-General believes that in these circumstances subscribers will gradually be converted to the measured rate tariff.

The telephone service in Sydney has of late assumed such large dimensions that additions to the plant and apparatus have been urgently needed. A new switchboard has now been added of the latest pattern, with a capacity for 3,599 lines.

Continental Notes.—France.—A direct telephone is now working between Paris and Nice, the length of the wire being 1,035 kilometres, and the diameter 5 mm.; the total cost of erection was 1,000,000 fr. This is the longest telephone line on French territory.

Lisbon.—The Anglo-Portuguese Telephone Co. has received advices from Lisbon that its new cable has been laid across the Tagus, and is a complete success.

Holland.—During the year 1904 the telegraphic system was increased by 132·6 kilometres of line and 809·5 of wire, and at December 31st, 1904, there were 6,912·9 kilometres of line and 30,412·5 of wire. Of 5,334 interruptions during the year, 18 were due to broken posts, 324 to broken wires, 2,394 to contact and 71 to faults, &c., in sub-fluvial and subterranean cables. Special experiments were made in connection with wireless telegraphy. A public wireless station was opened at Esheveningen, with power sufficient to communicate up to 200 kilometres, although a distance of 350 was reached. In 1904 there were 1,187 offices, as against 1,166 in 1903. There were 3,000,483 interior telegrams during the year, a decrease of 3·7 per cent. on 1903, and the average number of words per telegram was 14·36. The telephone was largely used in the delivery, &c., of telegrams. 75,367 telegrams to other countries were dealt with. 372,962 telegrams were exchanged with Belgium; 879,059 with Germany; 170,751 with France; and 711,268 with Great Britain. 34,767 telegrams were sent to and received from the Dutch East Indies, and 111,282 to and from the United States. The Anglo-American Telegraph Co. secured 76,638 telegrams (68·86 per cent.); the French Atlantic Cable, 4,052 (3·64 per cent.); and the German-American Cables, 30,573 (27·47 per cent.); the proportions for 1903 being 66·94 per cent., 2·93 per cent., and 29·13 per cent. respectively.

To make the use of the telephones more popular, new regulations were introduced, and prices for conversations were adjusted in order to obviate the rush at certain hours. The system in 1904 totalled 24,875·7 km. of wire and 2,302·3 of line, and the number of conversations amounted to 1,390,529, or an increase of about 21 per cent. over 1903; 58,179 conversations were with Germany and 40,246 with Belgium. Maintenance expenses on account of telegraphs amounted to 772,273 fr., and of telephones to 110,941 fr., while receipts from all sources amounted to 5,114,662 fr.; the disbursements were 8,681,437 fr., leaving a deficit of 3,566,775 fr.—*Journal Télégraphique.*

French Submarine Cables.—The ss. *François Arago*, belonging to the Société Industrielle des Téléphones, has been chartered by M. Grammont, and left Calais on 8th inst. for St. Tropez, there to load the Réunion-Mauritius, Réunion-Madagascar and Saigon-Pontianak cables.

Hull.—It is stated that arrangements have been made for the sale of the Hull Corporation telephone undertaking to the National Telephone Co. at cost price.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1.)	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Port Arthur-Chifu (Closed)	Mar. 7, 1904	
Jamaica-Colon	Jan. 5, 1905	
Cadiz-Tenerif	July 20, 1905	
Tarifa-Tangier	Jan. 18, 1904	
Puerto Plata-Martinique	Oct. 30, 1905	
St. Vincent-Grenada	Feb. 16, 1906	
St. Vincent-St. Lucia	Feb. 16, 1906	
Tangier-Cadiz	Feb. 18, 1906	
Grenada-Trinidad	Feb. 22, 1906	Mar. 12
Alexandria-Larnaca	Feb. 28, 1906	
Guadeloupe-Dominica	Mar. 6, 1906	Mar. 8
Landlines.		
Puerto-Barrios	Aug. 28, 1902	
Communication with Brazil *via* Galveston	July 18, 1905	
Bachkale-Deliman	Feb. 12, 1906	
Alaska Landlines	Mar. 9, 1906	

Manchester.—The Special Committee on Telephones has recommended that the claim of the Mutual Telephone Co., for compensation for the outlay undertaken and liabilities incurred by them in the formation of such company, be not complied with.

West American Cables.—The *Electrical World* (NY.) of February 17th says:—"The Bill introduced in Washington by Congressman Wagner of Pennsylvania, becomes law the Government will consolidate telegraph and cable business in the West Indies. The Bill appropriates $1,000,000 to construct a cable from the West Pan de Guantanamo, Cuba, and locate it to Haiti and to the shores of Panama. A branch line from Guantanamo to Port de Paix is also provided for. The commercial rate is fixed at not less than 40 cents a word, and reduced rate made for press matter. The Government has already one cable from Key West to Cuba, and one from Manila to the Philippines."

Trinidad.—The Chamber of Commerce has considered the offer to establish improved cable communication with Europe, submitted by the West India and Panama Telegraph Co., Ltd., and by the Bahama and Bermuda and the Direct West India Cable Companies, and upon the recommendation of the West India Committee, the proposals of the two latter companies have been transmitted to the Government.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—March 19th. One 400-kw. steam dynamo for the Corporation. See "Official Notices" March 2nd.

Belfast.—March 22nd. (1) Electric lighting and power installation. (2) telephones, for the New Municipal Technical Institute. Specifications at the Central Technical Institute, College Square North for (1) £2, and for (2) 5s. Payments not returnable.

Belgium.—April 19th. The municipal authorities of Courtrai are inviting tenders until April 19th for the concession for the public and private electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, Le Secretariat Communal de Courtrai, Belgium.

Bolton.—March 29th. Materials and stores for the electricity department; also one continuous current electric generator and one steam engine. See "Official Notices" March 9th.

Bray.—March 20th. Electrical supplies for the U.D.C. See "Official Notices" to-day.

Briton Ferry.—March 26th. Sub-station switchboard, feeder and distributor cables, feeders pillars, joint boxes, arc lamps and standards, for the U.D.C. See "Official Notices" March 2nd.

Chester.—March 31st. Construction and electrical equipment of tramways (permanent way, bonds, and overhead equipment, for the Corporation. See "Official Notices" March 9th.

Gillingham.—March 26th. Coal and meters for the electricity department. See "Official Notices" March 2nd.

Johannesburg.—March 31st. 350 street lamp fittings, 50 stays for ditto, and 600 ft. gas tarrel for the T.C. See "Official Notices" February 16th.

Leeds.—April 9th. Steam turbine, two-phase alternator and exciter (3,000 KW.), condensing plant and piping, for the electric lighting department. See "Official Notices" February 23rd.

L.C.C.—March 20th. Seven electrically-operated car traversers. See "Official Notices" March 2nd.

L.C.C.—March 26th. Lighting and power installation for the Long Grove Asylum, Epsom, now erecting. See "Official Notices" February 23rd.

L.C.C.—March 27th. High and low-tension switchgear for certain sub-stations. See "Official Notices" March 9th.

L.C.C.—March 27th. Three low-tension feeder switchboards for tramway sub-stations. See "Official Notices" to-day.

L.C.C.—March 27th. Eleven 500-KW. induction motor-generators, and three 50-KW. ditto, for tramway sub-stations. See "Official Notices" to-day.

Luton.—March 17th. Cables for the Corporation. See "Official Notices" March 9th.

Norwich.—March 19th. Wires, cables and lamps for the Electricity Department. See "Official Notices" March 9th.

Stockport.—March 29th. Electric motors, also steam-driven condensing plant for the electricity department. See "Official Notices" to-day.

Sunderland.—March 26th. Screw pile columns, &c., for tramways department. See "Official Notices" March 9th.

Sunderland.—March 26th. One 750-KW. three-phase steam alternator, one 30-KW. static transformer, and two rotating air compressors, for the electricity department. See "Official Notices" March 9th.

West Bromwich.—March 19th. One 440-KW. turbo-generator, &c. See "Official Notices" March 9th.

Willesden.—March 22nd. (1) Lamps for public street lighting, &c., for the U.D.C. See "Official Notices" March 9th.

Wrexham.—March 29th. Supplies for the Council's electricity department. See "Official Notices" March 9th.

CLOSED.

Aberdeen.—The Gas and Electricity Committee has been opened tenders for a new 2,000-KW. engine at the electricity works. The offer of Messrs. Dodds, Barroan & Co., Belfast, was accepted as the lowest tender, the figure being £475.

Australia.—The Electric Lighting & Traction Co. of Australia, Ltd., (Adelaide Electricity Supply) have placed an order with Messrs. Witting, Eborall & Co., Ltd., for two 115-KW. motor-generator sets, converting from low pressure continuous current to single-phase high pressure alternating current, these to be used in connection with extensions being carried out by the above-named company.

Bristol.—The Electrical Committee has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for extra high tension cables, for £7,687.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

For the Rangoon tramways (per B.T.-H. Co.), 10 single-deck bogie composite car bodies; 15 single-deck open car bodies.
For the Metropolitan Electric Tramways Co., 25 double-deck car bodies and four-wheel trucks; five double-deck car bodies.
For Adelaide, 750-KW. turbo-generator.
For Grimsby Corporation, 500-KW. steam dynamo.
For the Yorkshire Electric Power Co., Leeds, two 100-KW. transformers; four 50-KW. transformers.

Burnley.—The Corporation Electricity Committee has accepted the tender of the British Thomson-Houston Co. to supply motors and starters for the ensuing 12 months. The Committee has also accepted the tender of Messrs. Siemens Bros. for the supply of armoured cable.

Cardiff.—The City Asylums Committee on March 8th accepted the tender of Messrs. A. G. Arnold & Son, of Newport (Mon.), for the wiring of the new asylum at Whitchurch, at £6,334.

Cheltenham.—The T.C. has accepted the tender of Messrs. Danks, Ltd., for a new superheater for the Galloway boiler at the electricity works, at £85.

Colchester.—The T.C. on March 7th accepted the tender of Messrs. Davey, Paxman & Co., Ltd., for the supply of a combined triple-expansion double-acting engine and dynamo (Siemens Bros. and Co.), and to supply the needful spares, at £4,055. The tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of two tramcars, at £551 each, was also accepted.

Croydon.—The B.C. has accepted the tender of the British Westinghouse Co., Ltd., for 15 double-deck single-truck tramcars, for £7,822 10s.

Derby.—In view of the visit of the Royal Show to Derby during the forthcoming summer, the T.C. has ordered four more single-deck cars from Messrs. Milnes, Voss & Co., at £2,232.

Glasgow.—The Tramways Committee has accepted the following offers:—

Special junction work, the Lorain Steel Co.
Bonding, John Stewart & Co., Ltd.
Copper strip, William Clark & Son.
Ebonite sheets and plugs, W. C. Yuille & Co.
O'Brien de-icers, Stevens Bros. & Co.
Ivorine label-holders in boxes, the Hughes Label Co., Ltd.
Cross-cut saws, Wm. Lindley.
Axes and adzes, F. & B. Fleming & Co.
Street telephone parts, the General Electric Co.
Up-keep of mechanics' workers, Pinkstone, Babcock & Wilcox, Ltd.

The Electricity Committee of the T.C. has accepted the offer by Messrs. Ferranti, Ltd., amounting to £3,436, for high tension switchboards and instruments for St. Andrew's Cross Station. The offer was the lowest.

Liverpool.—The Corporation has accepted the tender of Messrs. Johnson & Phillips, Ltd., for 12 months' supply of electric cables and wires.

London.—The L. & S.W. Railway have accepted the tender of Messrs. Johnson & Phillips, Ltd., for six months' supply of cables and wires.

Marylebone.—The B.C. has accepted the following tenders in connection with the electricity undertaking:—

Messrs. [illegible] & Wilcox, Ltd., ash conveyor and motor equipment, £1,118.
Electrical [illegible] Storage Co., maintenance of two storage batteries at Rathbone Place and Manchester Square sub-stations for a period of 10 years, for a sum of £834 [illegible] annual payment of £784, being 6½ per cent. of the cost of the batteries.

Battersea.—The B.C. has accepted the following tenders for annual supplies in connection with the electricity undertaking:—

Duckham's [illegible] for lubricating oils.
Mobil Oil Co., for engine room stores (excepting lubricating oils).
Charles Sells, Dale & Co., for coals.
Siemens [illegible] for arc lamp carbons.
Electrical [illegible] Ltd., for electricity meters.
Callender's [illegible] Co., for service joint boxes: also for cables, &c.
T. Bennett [illegible] for arc lamp globes.

The Board has accepted the tender of Messrs. Reavell & Co. for an air compressor and accessories, at £89. They have also renewed the contract with the Electrical Co., Ltd., for Nernst lamps and globes, &c., for one year.

Fulham.—The B.C. has accepted the tender of Messrs. Aiton and Co. for water and exhaust piping in connection with the electricity works extension scheme, at £1,380. The tender of Messrs. Hall Bros., Ltd., at £1,284 6s. had previously been accepted. The firm, however, had written stating that they had made a mistake of £216 6s. in their tender.

Newcastle.—The Stirling Boiler Co., Ltd., have received a repeat order from the Newcastle and District Electric Lighting Co., Ltd., for two large Stirling boilers, each of 5,770 sq. ft. of heating surface, fitted with chain-grate stokers and superheaters of their manufacture.

Poole.—The T.C. has accepted the tender of the Brush Electrical Engineering Co., Ltd., for the construction of the new electricity works, at £26,168.

Sunderland.—The tender of Triumph Stoker, Ltd., has been accepted for mechanical stokers for the four new Galloway boilers for the Corporation electricity works at Hylton Road.

Wimbledon.—The T.C. has accepted the tender of the General Electric Co., Ltd., for an air-compressing plant at the Durnsford Road pumping station, for the sum of £701; also the tender of the Stanton Ironworks Co., Ltd., for cast-iron pipes for the [illegible] works extension, at £483 12s.

FORTHCOMING EVENTS.

To-day's [illegible] **Friday, March 16th).**—At 8 p.m. I.M.E. Adjourned discussion on "Large Locomotive Boilers," and paper on "Petroleum as Fuel for Locomotives," by Mr. L. Greaven.

At [illegible] Royal Institution. Mr. W. Duddell on "How to Improve the Telephone."

At [illegible] Students). Visit to the B. of T. Electrical Laboratory.

At [illegible] Institution of Engineers and Shipbuilders. Meeting.

At [illegible] Northampton Institute Engineering Society. Mr. W. F. Reeve on "Automobiles."

At 8 p.m. City of London College Science Society. Mr. S. W. Burnell "The Liquefaction of Gases."

Saturday, [illegible] 17th, at 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture III.)

At 7.30 p.m. Glasgow and West of Scotland Technical College. Mr. J. Murdoch on "Metals Used for Bearings of Shafting and Lubrication of Same."

At 8 p.m. City of London College Science Society. Visit to the Blackwall Tunnel Works.

At 8.30 p.m. Association of Engineers-in-Charge. Annual Dinner at the Alexandra Rooms, G.E. Hotel.

Monday, March 19th.—At 8 p.m. I.E.E. (Newcastle). Meeting at Armstrong College, Newcastle. Mr. Hooghwinkel on "Electric Winding considered Practically and Commercially."

At 8 p.m. Society of Arts. Cantor Lecture by Prof. V. B. Lewes on "Fire, Fire Risks and Fire Extinction." (Lecture II.)

Tuesday, March 20th.—At 8 p.m. Electrical Contractors' Association (Inc.), at Frascati's Restaurant. Mr. Rigby on "Gas Suction Plant."

Wednesday, March 21st.—At 8 p.m. Society of Arts. Mr. B. B. Redwood on "Motor Boats."

Thursday, March 22nd.—At 5 p.m. Royal Institution. Prof. B. Hopkinson on "Internal Combustion Engines." (Lecture I.)

At 6.15 p.m. Junior Institution of Engineers' Visit to Messrs. Fraser and Chalmers' Works at Erith.

At 8 p.m. I.E.E. Mr. C. P. Sparks on "Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.," and Mr. W. C. Mountain on "Electric Winding, Considered Practically and Commercially."

Friday, March 23rd.—At 5 p.m. Physical Society Meeting at University College, Gower Street. Prof. F. T. Trouton on "Unilateral Electric Conductivity over Damp Surfaces." Prof. J. A. Fleming on "The Construction and Use of Oscillation Valves for Rectifying High-Frequency Electric Currents."

At 7.30 p.m. I.E.E. (Manchester Students). Mr. R. C. C. Yates on "Lubrication and Lubricants," and Mr. W. Browning on "Notes on Electrical Conductivity."

Saturday, March 24th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture IV.)

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders are issued:—

Monday, March 19th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; N.C.O.'s class, 9 p.m.
Tuesday, March 20th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; medical examination recruits, 7 p.m.
Wednesday, March 21st.—"A" badge examination for "A" and "B" Companies.
Thursday, March 22nd.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Friday, March 23rd.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, March 24th.—Week-end instruction for "D" Company. "B" Company proceed to Gravesend to run the Defence Lights.

J. H. S. Phillips, Captain E.E.
For O.C.E.E.R.E. (V.).

NOTES.

The P. & O. Batti-Wallah's Dinner.—When he is at home in Hindustan a Batti-Wallah is the lampman, whence it is but a step to being an electric light man, and so the P. & O. Batti-Wallah's Society, which held its first annual dinner at the Holborn on March 10th, is comprised of past and present men who, as electrical engineers to the Peninsular and Oriental Steamship Co., are or have been responsible for lighting the company's ships on Britain's highway through the Gate of Asia, and thus doing their share towards displaying over half the globe the red ensign under which, and the shadow of the company's four-colour flag, we dined.

With the exception, perhaps, of one or two guests we had all been east of Suez, had roasted in the Red Sea, sweated at Aden, toiled over the deep blue of the Indian Ocean, seen the sunset over the Blue Mountains, taken a dip in the blue phosphorescence of the Canal, or even sat naked in the land of Egypt.

It was no trade dinner, but a purely social gathering of men who were drawn together by the tie of common employment under a flag that has done so much to spread a knowledge of our Empire's greatness. We could, therefore, be pleasant, even jovial and reminiscent, and one could hear the "East a-callin'", and go back to adventures with flying fish, and their accessories, to puttings off in frail pilot boats, adventures that excited, dynamos that didn't, hurricanes in the Southern Seas, glimpses of Fuji-Yama, of the bush and the Veldt, for some or other of us had seen these things. When we splashed home through the muddy streets, we heeded not because the tropic sun was warm overhead, and the temple bells were ringin', and so, as Pepys would say, to bed to dream ourselves back again on the Hoogly or the Irrawaddy, or passing through the Heads into Sydney, or moonlighting in Middle Harbour, or doing fifty other things that we had to do and didn't want to, or chose to do and didn't ought to.

Old and present Batti-Wallahs would do well to communicate with the secretary, Mr. E. Sheppard, or Mr. Waterhouse, this year's president; and when next the Batti-Wallahs meet in social gathering, may we be there to see and to call up half-forgotten scenes and things that happened when there were fewer years behind us, and we were only finding out the far-off places of our Empire.

Improved Insulating Covering for Small Wires.*—The Allgemeine Elektrisitäts Gesellschaft has recently put two improved types of insulation for fine wires on the market with a view to reducing the excessive waste of space involved by the use of ordinary cotton-covered, or even silk-covered, wires. The names given to these new insulations are "acetate wire," and "enamel wire" respectively. The first is produced by depositing numerous excessively thin layers of cellulose tetra-acetate on the wire. The result is a tough covering, not exceeding ·02 mm. in thickness, and which is capable of withstanding about 1,500 volts, is non-hygroscopic, and is not affected by temperatures up to 150° C. Acetate insulation is used on copper wires from ·07 to ·17 mm. (·00275 to ·0067 in.) in diameter. The following table shows the space efficiency of acetate wire, and of wires with the ordinary silk coverings. The space efficiency is taken as the ratio of the copper area to the area of the square described about the covered diameter of the wire:—

Diameter of wire in mm.	Space efficiency per cent.		
	Acetate wire.	Single silk covering.	Double silk covering.
·07	48	32	17
·08	50	35	20
·1	54	40	25
·12	57	44	29
·15	61	49	34
·18	64	53	38

* *E.T.Z.*, January 4th, 1906.

New American Cables.—The *Electrical World* (N.Y.) of February 17th says:—"If a Bill introduced at Washington by Congressman Wanger, of Pennsylvania, becomes law, the Government will embark in the telegraph and cable business in the West Indies. The Bill appropriates $1,000,000 to construct a cable from Key West, Fla., to Guantanamo, Cuba, and thence to the Canal zone on the Isthmus of Panama. A branch line from Guantanamo to Porto Rico is also provided for. The commercial rate is fixed at not less than 40 cents a word, and reduced rates made for Press matter. The Government has already done a great deal of signal corps cable work in the Philippines."

Trinidad.—The Chamber of Commerce has considered the offers to establish improved cable communication with Europe submitted by the West India and Panama Telegraph Co., Ltd., and by the Halifax and Bermudas and the Direct West India Cable Companies, and upon the recommendation of the West India Committee, the proposal of the two latter companies has been transmitted to the Government.

CONTRACTS OPEN and CLOSED.

OPEN.

Belfast.—March 19th. One 400-KW. steam dynamo for the Corporation. See "Official Notices" March 2nd.

Belfast.—March 22nd. (*a*) Electric lighting and power installation; (*b*) telephones, for the New Municipal Technical Institute. Specifications at the Central Technical Institute, College Square North, for (*a*) £1 and for (*b*) 5s. Payments not returnable.

Belgium.—April 19th. The municipal authorities of Couvin are inviting tenders until April 19th for the concession for the public and private electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, Le Secretariat Communal de Couvin, Belgium.

Bolton.—March 29th. Materials and stores for the electricity department; also one continuous current electric generator and one steam engine. See "Official Notices" March 9th.

Bray.—March 20th. Electrical supplies for the U.D.C. See "Official Notices" to-day.

Briton Ferry.—March 26th. Sub-station switchboard, feeder and distributor cables, feeders pillars, joint boxes, arc lamps and standards, for the U.D.C. See "Official Notices" March 2nd.

Chester.—March 31st. Construction and electrical equipment of tramways (permanent way, bonds, and overhead equipment, for the Corporation. See "Official Notices" March 9th.

Gillingham.—March 26th. Coal and meters for the electricity department. See "Official Notices" March 2nd.

Johannesburg.—March 31st. 350 street lamp fittings, 50 stays for ditto, and 600 ft. gas barrel for the T.C. See "Official Notices" February 16th.

Leeds.—April 9th. Steam turbine, two-phase alternator and exciter (3,000 KW.), condensing plant and piping, for the electric lighting department. See "Official Notices" February 23rd.

L.C.C.—March 20th. Seven electrically-operated car traversers. See "Official Notices" March 2nd.

L.C.C.—March 26th. Lighting and power installation for the Long Grove Asylum, Epsom, now erecting. See "Official Notices" February 23rd.

L.C.C.—March 27th. High and low-tension switchgear for certain sub-stations. See "Official Notices" March 9th.

L.C.C.—March 27th. Three low-tension feeder switchboards for tramway sub-stations. See "Official Notices" to-day.

L.C.C.—March 27th. Eleven 500-KW. induction motor-generators, and three 50-KW. ditto, for tramway sub-stations. See "Official Notices" to-day.

Luton.—March 17th. Cables for the Corporation. See "Official Notices" March 9th.

Norwich.—March 19th. Wires, cables and lamps for the Electricity Department. See "Official Notices" March 9th.

Stockport.—March 29th. Electric motors, also steam-driven condensing plant for the electricity department. See "Official Notices" to-day.

Sunderland.—March 28th. Stores, also ticket punches, for the tramways department. See "Official Notices" March 9th.

Sunderland.—March 30th. One 750-KW. three-phase steam alternator, one 300-KW. static transformer, and two portable air compressors for the electricity department. See "Official Notices" March 9th.

West Bromwich.—March 19th. One 400-KW. turbo-generator; exhaust pipes. See "Official Notices" March 9th.

Willesden.—March 22nd. 66 flame arc lamps for public street lighting for the U.D.C. See "Official Notices" March 9th.

Wrexham.—March 23rd. Supplies for the Council's electricity department. See "Official Notices" March 9th.

CLOSED.

Aberdeen.—The Gas and Electricity Committee last week opened tenders for a new fly-wheel in connection with a 1,200-H.P. engine at the electricity works. The offer of Messrs. Coombe, Barbour & Co., Belfast, was accepted as the lowest tender, the figure being £475.

Australia.—The Electric Lighting & Traction Co. of Australia, Ltd., (Adelaide Electricity Supply) have placed an order with Messrs. Witting, Eborall & Co., Ltd., for two 115-KW. motor-generator sets, converting from low pressure continuous current to single-phase high pressure alternating current, these to be used in connection with extensions being carried out by the above-named company.

Bristol.—The Electrical Committee has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for extra high tension cables, for £7,887.

Brush Contracts.—The following contracts have been booked by the Brush Electrical Engineering Co., Ltd.:—

For the Rangoon tramways (per B.T.-H. Co.), 10 single-deck bogie composite car bodies; 15 single-deck open car bodies.
For the Metropolitan Electric Tramways Co., 25 double-deck car bodies and four-wheel trucks; five double-deck car bodies.
For Adelaide, 750-KW. turbo-generator.
For Grimsby Corporation, 500-KW. steam dynamo.
For the Yorkshire Electric Power Co., Leeds, two 100-KW. transformers; four 50-KW. transformers.

Burnley.—The Corporation Electricity Committee has accepted the tender of the British Thomson-Houston Co. to supply motors and starters for the ensuing 12 months. The Committee has also accepted the tender of Messrs. Siemens Bros. for the supply of armoured cable.

Cardiff.—The City Asylums Committee on March 8th accepted the tender of Messrs. A. G. Arnold & Son, of Newport (Mon.), for the wiring of the new asylum at Whitchurch, at £6,334.

Cheltenham.—The T.C. has accepted the tender of Messrs. Danks, Ltd., for a new superheater for the Galloway boiler at the electricity works, at £85.

Colchester.—The T.C. on March 7th accepted the tender of Messrs. Davey, Paxman & Co., Ltd., for the supply of a combined triple-expansion double-acting engine and dynamo (Siemens Bros. and Co.), and to supply the needful spares, at £4,055. The tender of Messrs. Dick, Kerr & Co., Ltd., for the supply of two tramcars, at £551 each, was also accepted.

Croydon.—The B.C. has accepted the tender of the British Westinghouse Co., Ltd., for 15 double-deck single-truck tramcars, for £7,822 10s.

Derby.—In view of the visit of the Royal Show to Derby during the forthcoming summer, the T.C. has ordered four more single-deck cars from Messrs. Milnes, Voss & Co., at £2,232.

Glasgow.—The Tramways Committee has accepted the following offers:—

Special junction work, the Lorain Steel Co.
Bond plugs, John Stewart & Co., Ltd.
Copper strip, William Clark & Son.
Ebonite sleeves and plugs, W. C. Yuille & Co.
O'Bach dry cells, Siemens Bros. & Co.
Ivorine labels for switchboards, the Hughes Label Co., Ltd.
Cross-cut saws, Wm. Landell.
Axes and oil fillers, P. & R. Fleming & Co.
Street telephone parts, the General Electric Co.
Up-keep of mechanical stokers, Pinkston, Babcock & Wilcox, Ltd.

The Electricity Committee of the T.C. has accepted the offer by Messrs. Ferranti, Ltd., amounting to £3,436, for high tension switchboards and instruments for St. Andrew's Cross Station. The offer was the lowest.

Liverpool.—The Corporation has accepted the tender of Messrs. Johnson & Phillips, Ltd., for 12 months' supply of electric cables and wires.

London.—The L. & S.W. Railway have accepted the tender of Messrs. Johnson & Phillips, Ltd., for six months' supply of cables and wires.

MARYLEBONE.—The B.C. has accepted the following tenders in connection with the electricity undertaking:—

Messrs. Babcock & Wilcox, Ltd., ash conveyor and motor equipment, £1,118.
Electrical Power Storage Co., maintenance of two storage batteries at Rathbone Place and Manchester Square sub-stations for a period of 10 years, for a sum of £600, and an annual payment of £784, being 6½ per cent. of the cost of the batteries.

BATTERSEA.—The B.C. has accepted the following tenders for annual supplies in connection with the electricity undertaking:—

Duckham & Co., for lubricating oils.
Middleton Bros., for engine room stores (excepting lubricating oils).
Charrington, Sells, Dale & Co., for coals.
Geipel & Lange, for arc lamp carbons.
Electrical Co., Ltd., for electricity meters.
Callender's Cable Co., for service joint boxes; also for cables, &c.
T. Rowatt & Sons, for arc lamp globes.

The B.C. has accepted the tender of Messrs. Reavell & Co. for an air compressor and accessories, at £89. They have also renewed the contract of the Electrical Co., Ltd., for Nernst lamps and globes, burners, &c., for one year.

FULHAM.—The B.C. has accepted the tender of Messrs. Aiton & Co. for water and exhaust piping in connection with the electric lighting extension scheme, at £1,380. The tender of Messrs. Clapham Bros., Ltd., at £1,284 6s. had previously been accepted. The firm, however, had written stating that they had made a mistake of £216 6s. in their tender.

Newcastle.—The Stirling Boiler Co., Ltd., have received a repeat order from the Newcastle and District Electric Lighting Co., Ltd., for two large Stirling boilers, each of 5,770 sq. ft. of heating surface, fitted with chain-grate stokers and superheaters of their manufacture.

Poole.—The T.C. has accepted the tender of the Brush Electrical Engineering Co., Ltd., for the construction of the new electric tramways, at £26,168.

Sunderland.—The tender of Triumph Stoker, Ltd., has been accepted for mechanical stokers for the four new Galloway boilers for the Corporation electricity works at Hylton Road.

Wimbledon.—The T.C. has accepted the tender of the General Electric Co., Ltd., for an air-compressing plant at the Burnsford Road pumping station, for the sum of £701; also the tender of the Stanton Ironworks Co., Ltd., for cast-iron pipes for the electricity works extension, at £483 12s.

FORTHCOMING EVENTS.

To-day's Events (Friday, March 16th).—At 8 p.m. I.M.E. Adjourned discussion on "Large Locomotive Boilers," and paper on "Petroleum Fuel in Locomotives," by Mr. L. Greaven.
At 9 p.m. Royal Institution. Mr. W. Duddell on "How to Improve Telephony."
I.E.E. (Students). Visit to the B. of T. Electrical Laboratory.
N.E. Coast Institution of Engineers and Shipbuilders. Meeting.
At 4.45 p.m. Northampton Institute Engineering Society. Mr. W. F. Birch on "Automobiles."
At 8 p.m. City of London College Science Society. Mr. S. W. Burnell on "The Liquefaction of Gases."

Saturday, March 17th, at 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture III.)
At 7.30 p.m. Glasgow and West of Scotland Technical College. Mr J. Murdoch on "Metals Used for Bearings of Shafting and Lubrication of Same."
At 3 p.m. City of London College Science Society. Visit to the Rotherhithe Tunnel Works.
At 6.30 p.m. Association of Engineers-in-Charge. Annual Dinner at the Abercorn Rooms, G.E. Hotel.
Monday, March 19th.—At 8 p.m. I.E.E. (Newcastle). Meeting at Armstrong College, Newcastle. Mr. Hooghwinkel on "Electric Winding considered Practically and Commercially."
At 8 p.m. Society of Arts. Cantor Lecture by Prof. V. B. Lewes on "Fire, Fire Risks and Fire Extinction." (Lecture II.)
Tuesday, March 20th.—At 8 p.m. Electrical Contractors' Association (Inc.), at Frascati's Restaurant. Mr. Rigby on "Gas Suction Plant."
Wednesday, March 21st.—At 8 p.m. Society of Arts. Mr. B. B. Redwood on "Motor Boats."
Thursday, March 22nd.—At 5 p.m. Royal Institution. Prof. B. Hopkinson on "Internal Combustion Engines." (Lecture I.)
At 6.15 p.m. Junior Institution of Engineers' Visit to Messrs. Fraser and Chalmers' Works at Erith.
At 8 p.m. I.E.E. Mr. C. P. Sparks on "Electrical Equipment of the Aberdare Collieries of the Powell Duffryn Co.," and Mr. W. C. Mountain on "Electric Winding, Considered Practically and Commercially."
Friday, March 23rd.—At 5 p.m. Physical Society Meeting at University College, Gower Street. Prof. F. T. Trouton on "Unilateral Electric Conductivity over Damp Surfaces." Prof. J. A. Fleming on "The Construction and Use of Oscillation Valves for Rectifying High-Frequency Electric Currents."
At 7.30 p.m. I.E.E. (Manchester Students). Mr. R. C. C. Yates on "Lubrication and Lubricants," and Mr. W. Browning on "Notes on Electrical Conductivity."
Saturday, March 24th.—At 3 p.m. Royal Institution. Prof. J. J. Thomson on "The Corpuscular Theory of Matter." (Lecture IV.)

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

THE following orders are issued:—

Monday, March 19th.—"A" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; N.C.O.'s class, 9 p.m.
Tuesday, March 20th.—"B" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.; medical examination recruits, 7 p.m.
Wednesday, March 21st.—"A" badge examination for "A" and "B" Companies.
Thursday, March 22nd.—"C" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Friday, March 23rd.—"D" Company, recruits' infantry drill, 6 p.m.; technical instruction, 7 p.m.
Saturday, March 24th.—Week-end instruction for "D" Company. "B" Company proceed to Gravesend to run the Defence Lights.

J. H. S. PHILLIPS, Captain E.E.
For O.C.E.E.R.E. (V.).

NOTES.

The P. & O. Batti-Wallah's Dinner.—When he is at home in Hindustan a Batti-Wallah is the lampman, whence it is but a step to being an electric light man, and so the P. & O. Batti-Wallah's Society, which held its first annual dinner at the Holborn on March 10th, is comprised of past and present men who, as electrical engineers to the Peninsular and Oriental Steamship Co., are or have been responsible for lighting the company's ships on Britain's highway through the Gate of Asia, and thus doing their share towards displaying over half the globe the red ensign under which, and the shadow of the company's four-colour flag, we dined.

With the exception, perhaps, of one or two guests we had all been east of Suez, had roasted in the Red Sea, sweated at Aden, toiled over the deep blue of the Indian Ocean, seen the sunset over the Blue Mountains, taken a dip in the blue phosphorescence of the Canal, or even sat naked in the land of Egypt.

It was no trade dinner, but a purely social gathering of men who were drawn together by the tie of common employment under a flag that has done so much to spread a knowledge of our Empire's greatness. We could, therefore, be pleasant, even jovial and reminiscent, and one could hear the "East a-callin'", and go back to adventures with flying fish, and their accessories, to puttings off in frail pilot boats, adventures that excited, dynamos that didn't, hurricanes in the Southern Seas, glimpses of Fuji-Yama, of the bush and the Veldt, for some or other of us had seen these things. When we splashed home through the muddy streets, we heeded not because the tropic sun was warm overhead, and the temple bells were ringin', and so, as Pepys would say, to bed to dream ourselves back again on the Hoogly or the Irrawaddy, or passing through the Heads into Sydney, or moonlighting in Middle Harbour, or doing fifty other things that we had to do and didn't want to, or chose to do and didn't ought to.

Old and present Batti-Wallahs would do well to communicate with the secretary, Mr. E. Sheppard, or Mr. Waterhouse, this year's president; and when next the Batti-Wallahs meet in social gathering, may we be there to see and to call up half-forgotten scenes and things that happened when there were fewer years behind us, and we were only finding out the far-off places of our Empire.

Improved Insulating Covering for Small Wires.*—The Allgemeine Elektrizitäts Gesellschaft has recently put two improved types of insulation for fine wires on the market with a view to reducing the excessive waste of space involved by the use of ordinary cotton-covered, or even silk-covered, wires. The names given to these new insulations are "acetate wire," and "enamel wire" respectively. The first is produced by depositing numerous excessively thin layers of cellulose tetra-acetate on the wire. The result is a tough covering, not exceeding ·02 mm. in thickness, and which is capable of withstanding about 1,500 volts, is non-hygroscopic, and is not affected by temperatures up to 150° C. Acetate insulation is used on copper wires from ·07 to ·17 mm. (·00275 to ·0067 in.) in diameter. The following table shows the space efficiency of acetate wire, and of wires with the ordinary silk coverings. The space efficiency is taken as the ratio of the copper area to the area of the square described about the covered diameter of the wire:—

Diameter of wire in mm.	Space efficiency per cent.		
	Acetate wire.	Single silk covering.	Double silk covering.
·07	48	32	17
·08	50	35	20
·1	54	40	25
·12	57	44	29
·15	61	49	34
·18	64	53	38

* *E.T.Z.*, January 4th, 1906.

"Enamel wire" is supplied in somewhat larger sizes, viz., from ·2 up to 2 mm. (·008 to ·08 in.) diameter. The covering is from ·015 to ·025 mm. thick, according to the diameter of the wire, it is unaffected by temperatures up to 200° C., and possesses great elasticity and toughness. The breakdown pressure is 2,500-3,000 volts when dry, is about 2,000-2,500 volts for a single wire under mercury, and is from 800 to 1,000 volts when the wire has been under water for 24 hours. This covering also is non-hygroscopic, is unaffected by brine or vinegar except at high temperatures and by sulphuric acid, except when of great density. It cannot, however, withstand the action of alkalies, and is affected at ordinary temperatures by turpentine and chloroform, and at high temperatures by benzine benzol, alcohol and aceton. The space efficiency of this wire is shown below:—

Diameter of wire in mm.	Space efficiency per cent.				
	Enamel wire.	Single silk covering.	Double silk covering.	Single cotton covering.	Double cotton covering.
·2	56	55	41	40-42	20-29
·5	65	64	53	53-57	40-46
1·0	72	72	65	55-65	40-55
1·5	73	—	69	61	49-61
2	74	—	—	65	54-65

A Novel Railroad Motor-Coach.—In the States there is never any hesitation about employing new types of machinery if there is the least suspicion that economy will result. This virtue is not self-evident from the description of the experimental gasoline-electric coach which appears in the *Railway and Engineering Review*, but, at least, the departure is a novel one, which calls to mind the Heilmann locomotive. The motor-coach has been built for the Delaware and Hudson Railway by the G.E. Co. and the American Locomotive Works, and comprises engine room, luggage compartment, smoking room, passengers' compartment, lavatory and motorman's compartment. It is 65 ft. long, weighs 65 tons, and seats 40 passengers. The gasoline engine was built, it is satisfactory to learn, by the Wolseley Tool and Motor-Car Co., of Birmingham. It has six cylinders horizontally opposed, of 9 in. diameter × 10 in. stroke, and develops 160 B.H.P. at 450 r.p.m. The starting difficulty with an engine of this size is overcome by firing, by means of a hand trigger, a charge of black powder in one cylinder.

The ignition consists of both high and low tension devices, the latter including a small magneto driven from the shaft. Two carburettors integral with the engine are employed, each being equipped with two float feed chambers and supplying three cylinders. The air supply may be taken from the atmosphere, the crank chamber, or both. Forced lubrication is used for main bearings and pistons. The gasoline is stored under the car and the cooling water in the engine base, whilst the cooling tubes are on the roof. The car can be heated by the circulating water when required.

The electrical equipment consists of a 120-KW. 600-volt direct coupled generator, a 5½-KW. compound-wound exciter driven therefrom by a silent chain, and two G.E. 69-B. 200-H.P. motors, which are controlled from either end of the coach. As voltage control has been adopted for varying the speed, the generator is provided with commutator poles, which are specially advantageous for giving a large current at low voltage with weak field excitation at starting. Although the generator is shunt-wound, it is separately excited in order to meet these conditions. The controllers can be set for any predetermined maximum acceleration. They are arranged for series-parallel control with five positions, "series ahead," "parallel ahead," "off," "series reverse," and "parallel reverse." The method of governing the speed of the car by varying the field of the generator, ensures that the speed of the engine remains constant during acceleration. At the trial a speed of from 35 to 40 miles an hour was reached, whilst the acceleration was rapid, and there was an absence of vibration.

It would be interesting to have some figures of running costs of this car so as to compare with the steam motor-coaches which are considered quite satisfactory in this country, although we believe that petrol-driven coaches are also in use. The only advantage of the system described, appears to be the control, which could not be obtained with a direct petrol-driven coach. But is this worth the expense of the electrical equipment? We do not go so far as to consider electricity a universal panacea.

Railway Train Lighting.—Our contemporary, the *Gas World*, discourses sagely on the recent accident on the Great Central Railway, and remarks that more important than the question of what will happen after an accident is "the question of which is the more efficient, safe and cheap illuminant while the train is in motion." After, of course, according the palm to gas, it goes on: "On the question of efficiency there can be little doubt as to the verdict of railway passengers in general; nor can the relative costs of the two lights be considered an open question." Quite so. We cannot, however, agree that "on the score of safety it may be doubted whether there is anything to choose between the two. The hypothetical consequences of an accident on the Great Central or any other railway might have been still more 'terrible' than they were in the present instance it, through the fusion of a wire, or some other hidden danger attending the use of electric lamps, the train had gone on fire while running at full speed. Trains have gone on fire from such causes before now, and but for the prompt extinction of the flames the results must have been very serious. It is well to remember contingencies of this kind at a time when, on the authority of a Government official, the newspapers are proclaiming, in big headlines, the 'Danger of Gas in Trains.'"

We fail to see the existence of the hypothetical danger referred to; we have heard of trains being set on fire by gas often enough, but never by electricity. But our friends will soon be relieved of the painful sensations indicated in their last sentence, for all the new trains on the Great Central are lighted by electricity, all their suburban trains are so lighted, and all new trains on all up to date systems are lighted in this way. There will soon be no "Danger of Gas in Trains."

Rand Power Supply.—In the report of the Vereeniging Estates, Ltd., there is certain information in reference to the supply of electrical power for working the mines in the Witwatersrand. The directors state that "various localities have been indicated at a greater or lesser distance from Johannesburg and the points of consumption, but it is not too much to say that there is not one of them which is so favourably situated as your estate, or where there are so many advantages of coal, water, and otherwise, placed close together, ready for use, as in your case. From your coal mines to Johannesburg, in a direct line, is only a distance of about 32 miles. This subject has received due attention. The Government has been approached in regard to the required wayleave, and a powerful syndicate, which will be provided to find the required capital, has been formed. Two of their expert advisers left Europe on the 27th of last month, and are now on their way to your estate. They will make the necessary investigations of detail. The completion of this scheme will enable very considerable economies to be effected in capital outlay and in the working costs of the mines of the Transvaal."

Chatham Electrical School.—The large Electrical School built for the Royal Engineers of the School of Military Engineering at Brompton Barracks, Chatham, is fast approaching completion. It is a very imposing structure standing on the great lines in close touch with all the fortifications. The old electrical school is within the R.E. barracks.

Telephony without Wires.—A gentleman of Swansea, who is sufficiently versed in the art of advertising himself to need no assistance, has for some time past been paralysing the local Press with long-winded accounts of his marvellous discovery of wireless telephony, with as many as five headlines. He claims to have been at work on this subject for nearly 15 years, "during which a sum of £13,000 has been spent" (and much water has run under the bridges). It is amusing at first—afterwards sickening—to read his appreciative comments on the merits of his invention. For him, distance has no terrors. Not content with wirelessly telephoning (in imagination) from Liverpool to London, he has "very good reasons for believing" that communication could as easily be established on his system between Great Britain and New York, Melbourne, and so on! "On the surface this may appear an exaggeration. I do not think so! True, experiments have not yet been made over these very long distances." How remarkably true! So long as he confined himself to his own imaginary achievements we should have taken no notice of him or them; but when this cocksure person begins to decry the real achievements of others we cannot keep silence. Referring to Herr Ruhmer's successful telephony along light rays, he says, "May I say the whole thing is hokus pokus?" The use of selenium excited his mirth. "I would like to help the young German, but he is on the wrong tack altogether; he'll never do it that way!"

Electrical men need no guidance from us as to a choice between the statements of Herr Ruhmer and those of an inventor of this stamp. We would, however, suggest to our Welsh contemporaries, that their columns are worthy of a better fate than to be filled with egregious nonsense, which cannot be properly characterised in print.

Fletcher Bros., Ltd., v. the British Westinghouse Electric Manufacturing Co.—This case came before Mr. Justice Bray, in the King's Bench Division on Monday; an action by the plaintiffs against the defendants for the price of goods sold and damages for alleged breach of contract. Defendants also counterclaimed for damages. Mr. Langdon, K.C., in opening the case, said plaintiffs were manufacturers of valves for steam piping, and the dispute arose in reference to a contract for the delivery of a number of valves in connection with the power house of the Metropolitan Railway at Neasden. Plaintiffs claimed the price of the valves they had delivered and for certain extras. With reference to the breach of contract, plaintiffs alleged there was a contract in writing, not only for the supply of the valves for the Metropolitan system, but also for the valves for the Yoker and Motherwell power stations for the Clyde Valley Electric Power Co. Plaintiffs said that they were entitled on the correspondence to have these orders placed with them, and as the defendants had refused to so place them, they asked for damages. Defendants said that the valves supplied were defective, and that in consequence of a delay they were exonerated from the liability of placing certain orders with the plaintiffs. With reference to the allegation that the valves were defective and that there had been delay, defendants counterclaimed for damages. In the result the case was settled, the terms of the settlement not being stated.

(*Continued on page* 435.)

ROTATING TOWER CRANE FOR THE DUBLIN PORT AND DOCKS BOARD.

There has recently been installed for the Port and Docks Board, Dublin, an electrically-operated rotating tower crane, to deal with normal working loads of 100 tons.

This crane, which is shown in fig. 1, was erected by the Vereinigte Maschinenfabrik Augsburg und Maschinenbaugesellschaft Nuernberg A.G., and was put into service in the middle of June last.

The rotating part of this gigantic crane consists of a vertical crane-post with a horizontal braced truss over it. The lower part of the crane-post rests on a cylindrical bearing, whilst the upper horizontal thrust is borne by means of rollers on a ring bearing fixed to the trestle, surrounding the crane-post.

The machinery for hoisting and for traversing the hoisting crab (shown in fig. 4), is housed in a machine room, which, together with the counterweight, is erected on the short arm of the truss. The hoisting crab (shown in figs. 2 and 5) runs on the long arm of the truss between the two side girders, which are suitably braced together: it is provided with an auxiliary hoisting gear of 20 tons working capacity, and 30 tons maximum carrying capacity.

The motors, and indeed all the electrical equipment for the crane, were supplied by Messrs. Siemens Bros. & Co.: the main and auxiliary lifting motors for operating the hoists are of 60 and 40 B.H.P. respectively, with speeds of 650 r.p.m., and operate on 500-volt D.C. circuits.

The motor for travelling the crab is of similar type, 30 B.H.P. in size, with a speed of 750 r.p.m.

The slewing mechanism shown in fig. 3 is arranged on the lower platform at the junction of the crane-post and the truss. The operation of slewing is performed by a 15-B.H.P. 500-volt geared motor, with a speed of 570 r.p.m.

The driver's house, from which the crane is operated, is situated on an upper platform above the slewing gear.

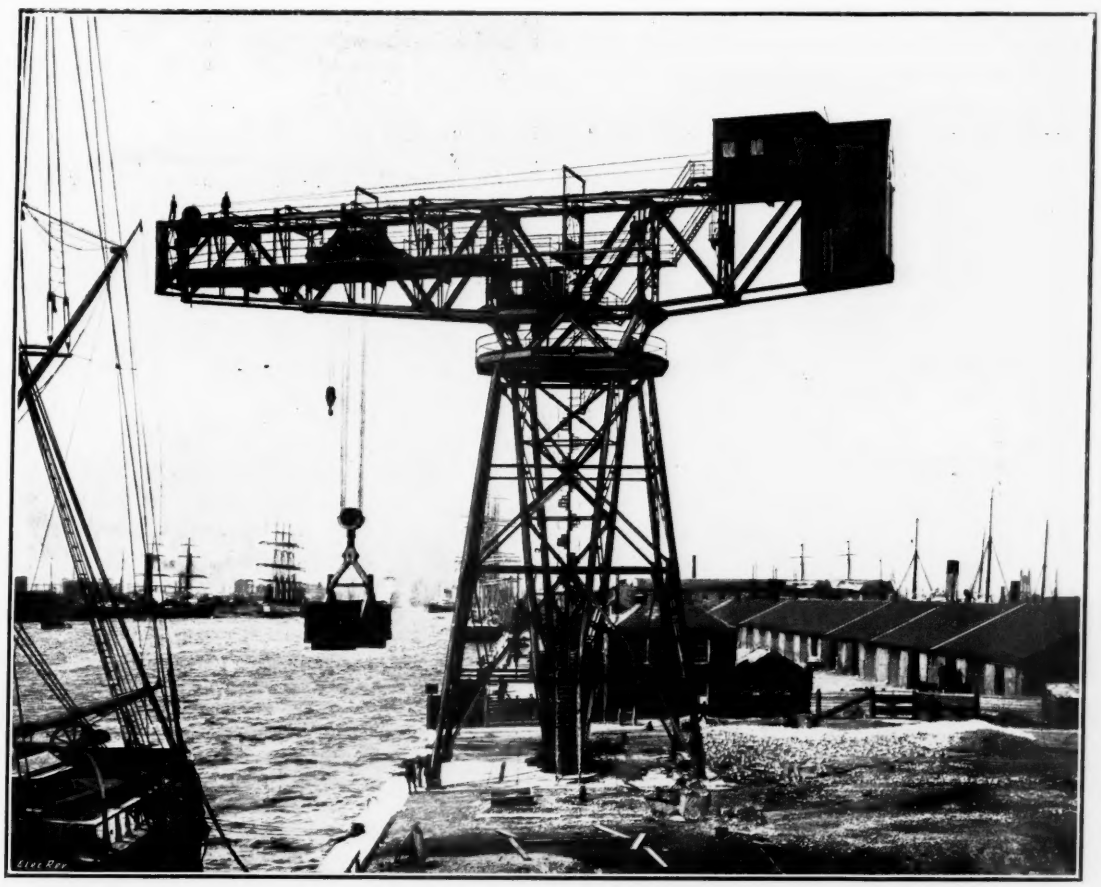


Fig. 1.—Electrically Operated 100-Ton Crane for the Dublin Port and Docks Board.

From this position the driver has a good view of the working field of the crane. The driver's house contains controllers of Messrs. Siemens standard M.C. complete reversing type, fitted with hand-wheels, indicating the "off" position: the hoisting controllers have a greater number of control points on the lifting side than on the lowering side.

A switchboard, built on a hinged iron frame contains the subsidiary switchgear for the motors, the equipment including:—For the main lift motor, a D.P. quick break switch and S.P. maximum cut-out; auxiliary lift motor, a S.P. fuse and S.P. maximum cut-out: traversing motor, a S.P. fuse and a D.P. switch: and slewing motor, S.P. fuses, and a D.P. switch.

The collecting gear is of the firm's standard type, and the

lifting motors are provided with electrically-released brakes for holding the load when the power is off.

Conveniently arranged staircases lead to the machine room and to the platforms on the cross-truss, as well as to the driver's house.

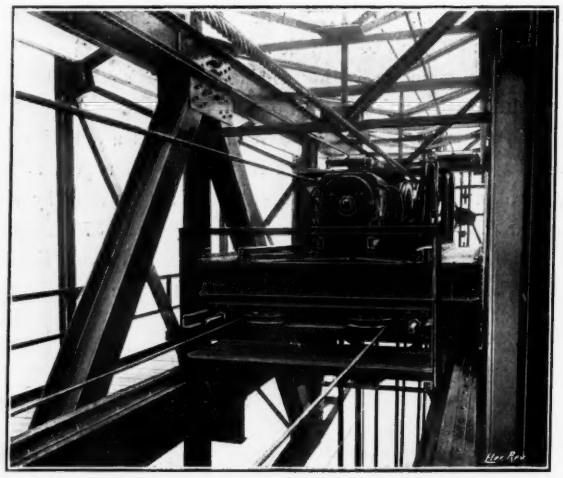


Fig. 2.—The Hoisting Crab.

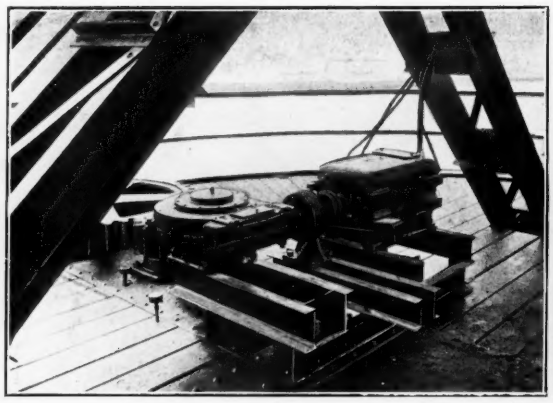


Fig. 3. The Slewing Gear

The chief dimensions of the crane are :—

Greatest height of the load-hook above the quay wall...	70ft.
„ hoisting height	100 „
„ radius for 20 tons	80 „
„ „ „ 160 „	75 „

The working speed is :—

When hoisting 150 tons	...	3 ft. per minute.	
„ „ 50 „	...	10 „	„
„ „ 20 „	...	20 „	„
Speed of traveller ...	...	28 „	„

Time taken for a complete rotation, 8 minutes.

The crane is for loading large and heavy articles—for instance, boilers, machines, guns, &c. The trial movements, made singly and in combination with the loaded crane, were carried out, with complete satisfaction. The ports of Hamburg and Emden already possess five cranes on the same system, which were also supplied by the same makers.

Liverpool Electricity Supply.—A deputation from the Commercial and Traders' Council waited on the Tramways and E.P. and L. Committee on Friday last, to ask for a reduction in the price of electricity as from January 1st last. The Committee promised to take the matter into consideration.

The question of deposits being required from new consumers of energy has come before the City Council. It was pointed out that such a stipulation deterred many, and even precluded small consumers from taking a supply. The matter has been referred back for consideration.

TWO-PHASE ALTERNATORS FOR JOHANNESBURG MUNICIPALITY.

Messrs. Siemens Bros. & Co. have recently designed and constructed four two-phase alternators for the Johannesburg Municipal electrical scheme.

These machines comprise two of 1,350 kw. and two of 675 kw. capacity (·75 p.f.) respectively, built for a working pressure of 3,300 volts and 50 cycles per second ; the speeds being 100 and 125 r.p.m. respectively. They are designed for direct coupling to gas engines, to the specification of Messrs. Mordey & Dawbarn, and had to fulfil the most stringent guarantees. The temperature rise was guaranteed not to exceed 50° F. in any part, after running for 12 hours at full load, and this temperature rise was not exceeded on test. The size of the machines was determined principally by the low excitation loss and the small rise of voltage on throwing off the load required by the specification. The 675-kw. sets have an excitation loss of only 1·1 per cent. of the output. When running at full load on a ·75 power factor, the rise of voltage on throwing off the full non-inductive load is only $4\frac{1}{2}$ per cent. Similar results have been obtained on the 1,350-kw. sets, the leading features of which are given below.

The stator frame, cast in four pieces, is efficiently cooled by the current of air set up by the rotor. The stator plates are firmly clamped, by means of insulated bolts between two cast-steel angle plates, which are fixed to the stator frame.

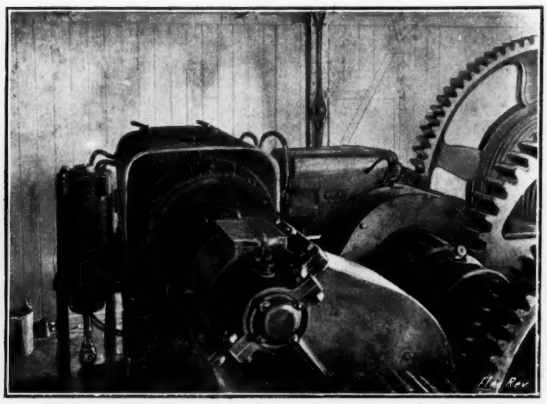


Fig. 4.—The Hoisting Motors.

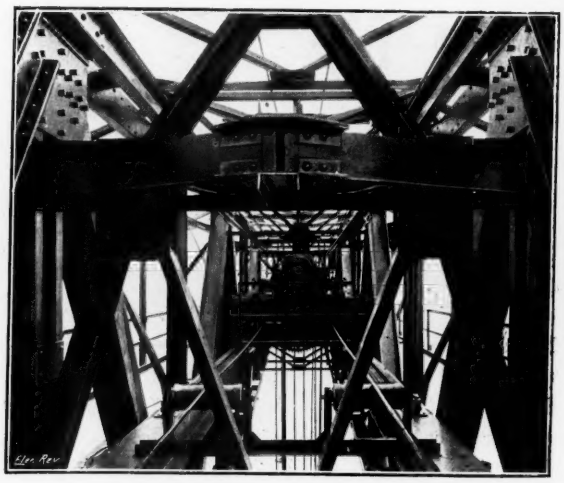


Fig. 5.—View of the Traversing Gantry and Crab.

The core, 260 in. diameter and 10 in. wide, is built up of insulated laminated stampings : the slots (four per pole per phase) are open, and the former-wound stator coils are

held firmly in place by wooden keys. This construction allows the coils to be thoroughly insulated before they are slipped into position, and also provides for repairs or renewals being easily made. The coils are insulated with mica, which is moulded on to the straight part; the mica insulation projects a sufficient distance beyond the stator core, to ensure a leakage distance requisite for the voltage of the machine.

The ends of the coils are taped with special oiled tape, and thoroughly protected by the shields on the frame.

Sixty rotor poles are attached to the cast-steel wheel, the rim of which is of U section. The segments of the rim are held together by shrunk keys inside the rim. Lateral movement is prevented by round keys fixed in the rim. The hub is held together by shrunk rings.

The poles are of circular section, and are secured to facings on the periphery of the wheel by means of screws, provided with lock washers, to ensure their not working loose. Steady pins prevent the poles from turning. The pole-shoes are of thin stampings securely riveted together, and are attached to the pole by means of four locked countersunk screws: the air gap is 6·6 mm.

The rotor coils are wound on metal formers which fit over the poles, and are held in position by a flange on the pole itself, an arrangement well suited to the conditions here obtaining.

A damaged rotor coil can easily be replaced by taking off the pole, and the stator windings can be removed with equal facility. The excitation pressure is 230 volts.

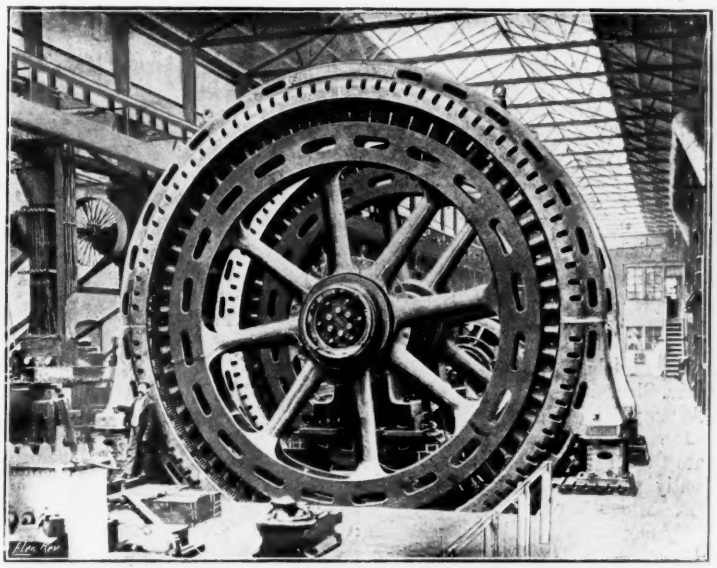


Fig. 1.—Siemens Alternators for Johannesburg.

From the stator coils, leads are taken to porcelain terminals mounted on the underside of the stator frame, which, although readily accessible, are yet out of all danger from casual or accidental contact. The stator coils are also so placed that, should moisture collect on the machine from any cause, they are thoroughly protected. From the rotor coils, leads are taken to brass slip-rings supported on insulated pins, which are screwed into the boss of the rope wheel that drives the exciter. Energy is collected from these by means of two carbon brushes on each ring, so that one can always be lifted off or replaced without in any way interfering with the operation of the machine.

On Monday last, through the courtesy of Messrs. Siemens, we were enabled to inspect these machines running under full load test at the firm's works at Stafford.

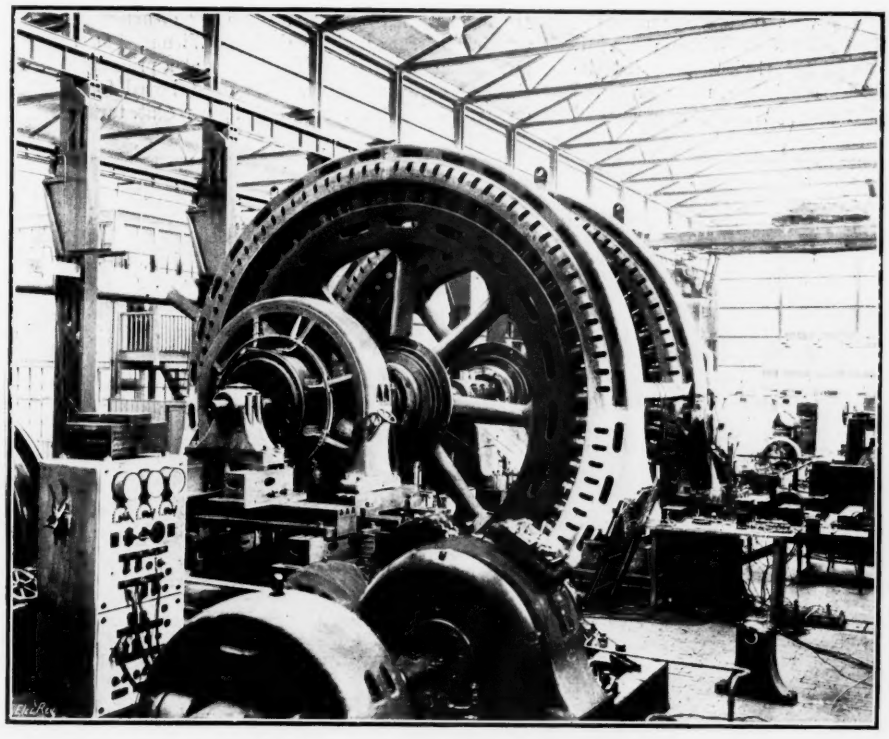


Fig. 2.—Two 1,350-kw. Two-Phase Alternators for Johannesburg, under Test.

The two machines were coupled together, the Hopkinson method of testing being followed, and the necessary power to overcome the losses in the two machines was supplied by a 66-h.p. d.c. motor coupled to the end of the main shaft; the arrangement is clearly shown in fig. 2.

By varying the position of the stator windings from the normal, so as to give a phase displacement of about 25 electrical degrees, the normal full-load current, 205 amperes, with a power factor of unity, was supplied by the leading machine, developing 1,350 kw. as a generator, to the second machine working as a motor with slightly reduced flux: the normal excitation being applied in each case.

By suitably varying the excitation of the two machines, the normal full-load current, 273 amperes at ·75 power factor, was obtained.

The total losses of one alternator without bearing friction were 83 kw., with an output of 1,377 kw., thus giving an

efficiency, including all losses, of 94·3 per cent., with a power factor of unity.

Owing to the low temperature rise called for in the specification, the machines are considerably underrated, and if the firm's standard temperature rise of 70° F. were allowed they would, in the ordinary way, be supplied for outputs of 2,400 KVA.

In addition to the inspection of the above machines, Monday's visit was the occasion of a general tour on the part of the technical Press, of Messrs. Siemens's up-to-date works, which it may be noted were fully described and illustrated in the ELECTRICAL REVIEW of August 19th and 26th, 1904.

The visit served to remind us of the comprehensive character of the work carried out by the firm, the visitors inspecting the numerous types of direct and alternating-current machinery specialised in by Messrs. Siemens.

Among the items of special interest at the present time, were a single-phase train control equipment; a recently perfected train lighting equipment, which we understand will shortly meet with practical application: and examples of Siemens-Ilgner electrical winding plant and Siemens turbo-generators, for which the firm have some important orders in hand, and to which we hope to make further reference at a later date.

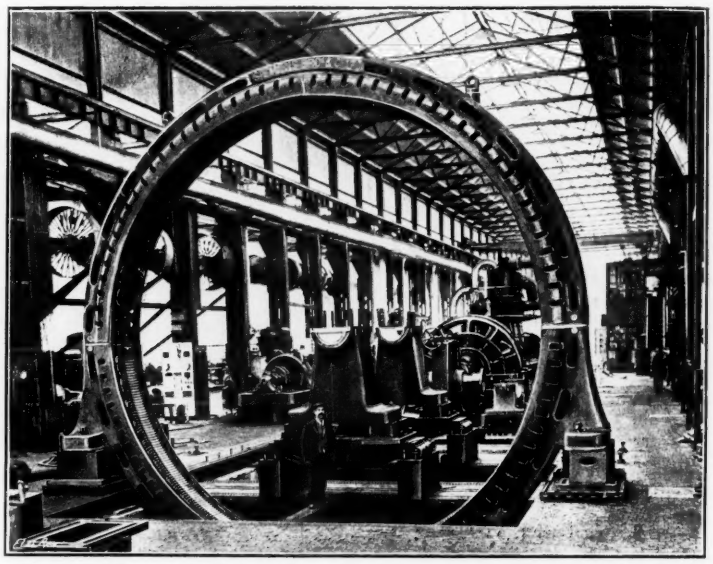
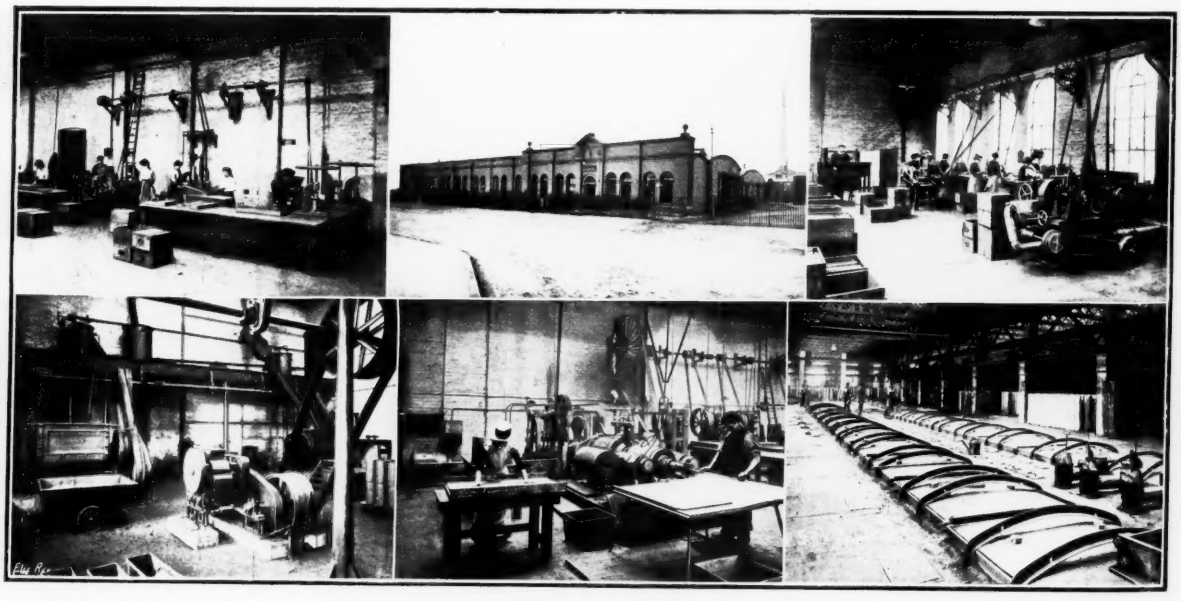


FIG. 3.—VIEW OF STATOR: 1,350-KW. ALTERNATOR

BRITISH-MADE CARBONS.

ON Friday last we took part in a visit of inspection to the General Electric Co.'s Carbon Works at Witton; Mr. M. Railing, one of the directors of the G.E. Co., headed the party, supported by Mr. Maurice Solomon, manager of the Carbon Works, and Messrs. Dumas, Wilson, Palmer, and other members of the staff. On arrival at Birmingham, the visitors were entertained at luncheon, and Mr. Railing briefly sketched the history of the undertaking. When the business was taken in hand by the company, from 20 to 25 million metres of foreign-made carbons were annually consumed in this country. The plant installed at Witton was designed for an output of 5,000,000 metres a year, and cost £75,000, employing 250 to 300 hands. Serious difficulties were encountered in training the workpeople in this new industry, 50 per cent. of them proving unsatisfactory; but when the preliminary troubles had been overcome, first-class carbons were turned out, equal to the Continental product in every respect.

Unfortunately, in five years the prices were reduced from 45s. per 1,000 ft. (12 mm.) to 22s. or 23s.—a fact which Mr. Railing attributed entirely to unfair competition. He had satisfied himself that the cost of manufacture on the Continent was equal to that at Witton, but the surplus production was sold in this country at a price actually below the cost of manufacture. They had hoped for some assistance from the Government—a 10 per cent. tariff on imports would suffice to enable them to keep going—but they could not look to the present Government for protection. The industry was of great importance to the nation, and ought to be supported by the Admiralty and the War Department, by



Coring Machines. Mixing Machines. Exterior of Works. Hydraulic Press. Grinding Machines. Baking Ovens.

THE GENERAL ELECTRIC CO.'S CARBON WORKS AT WITTON.

railway companies, &c. They appealed to purchasers to take account of the circumstances and to give preference to British-made carbons, for if the Witton Works were shut down, the price of carbons would at once rise enormously. So long as the conditions were so adverse it was impossible for British firms to carry out costly researches and to develop new ideas. On the Continent industries were supported and encouraged by the National Governments, but here no help was given.

An illustrated description of the Carbon Works was given in our issue of February 13th, 1903, and a number of views are reproduced on the opposite page.

The raw material consists of gas retort carbon, soot and tar. The carbon on arrival contains about 6 per cent. of ash, and has to be carefully hand-picked in order to eliminate the latter as far as possible, a maximum of ½ per cent. in the final product being the limit allowed. Only about one-third of the bulk is found suitable for use. The carbon is then crushed and ground to powder in ball or roller mills. The soot is specially manufactured from oil fuel, and the tar is also of special quality. The three constituents are next thoroughly mixed in steam-heated kneading machines and calenders, and the material is then stamped into cylinders ready for use in the hydraulic presses.

The latter extrude the carbon through steel dies, with or without needle centres to provide for cores; the dies wear rapidly, and usually last only for one day's work, corresponding to 45,000 ft. (12 mm. in diameter). The carbon rod is cut into lengths of about 3 ft. as it comes from the press, and these are straightened by rolling down an inclined plane. When cold they become stiff, and are tied up in bundles to fit the crucibles, in which they are packed with carbon dust to prevent the access of air to the carbons.

The furnaces are arranged in a ring, and are heated by producer gas to a temperature of 1,670° C. The process is continuous, the air required for combustion being passed through chambers containing carbons which have been baked and are cooling down, while the waste gases pass through chambers which are being heated; the gas can be admitted to any chamber at will from a central duct, by means of the inverted U-tubes seen in the view. When a batch of carbons has been fully baked, the gas is transferred to the next in succession, a newly filled chamber is brought into the circuit of the waste gases, and a cooled batch of carbons is removed from the other end.

The next process is to cut the carbons to length in a guillotine machine, and to sort out the bent ones by allowing them to roll down an incline; the straight carbons roll through between two parallel plates, but the bent ones are caught. The ends of the straight carbons are then ground flat, and one end is pointed, by automatic grinding machines. Finally, the dust is blown out of the interior of carbons which are to be cored, the core mixture is pumped in, and the cored carbons are dried in an oven.

Three qualities of carbon are made at Witton: the "Apostle," for use in open arc lamps; the "Nubia," a higher grade of carbon; and the "Witton," for enclosed arcs. Flame and searchlight carbons are also made, the latter, if necessary, being coppered, and battery carbons, switch contacts, manganese blocks &c. The battery carbons are made with solid carbon heads, into which the brass terminals are screwed.

Tests made at the National Physical Laboratory in July last year showed that the Apostle carbons were practically identical in quality with two well-known Continental makes tested at the same time, and the report stated that all three types were of "high grade quality."

After inspecting the Carbon Works, the visitors made the tour of the adjoining engineering works, where the manufacture of dynamos, alternators, motors &c. was in full swing. It was stated that an order valued at £25,000 for Portsmouth Dockyard was being filled there, and that 400 motors of about 45 H.P. each were being built for the Underground Electric Railways, London. Evidently, therefore, these works—which have recently been extended—are far from sharing the depression from which the less fortunate Carbon Works are suffering.

We are greatly indebted to all of the General Electric Co.'s staff whose courtesy and hospitality we enjoyed on the occasion of our visit.

NOTES.

(*Concluded from page* 430.)

Electrical Power Storage, Ltd., v. Patents Exploitation, Ltd.—In the Chancery Division on Wednesday, Mr. Justice Joyce had before him this case. The plaintiffs were the exclusive licensees from the defendants of a patent for the manufacture of dry electric batteries, and the question in the case was whether the licensees were entitled to share in the damages recovered from an infringer by the owner of the patent. Mr. Hughes, K.C., for the plaintiffs, referred to an agreement between the defendants, the owners of the patent, and the plaintiffs, who were to have an exclusive licence to manufacture under the patent on payment of certain royalties. There was a clause in the agreement to the effect that if at any time in the opinion of both the parties to this agreement, any third party be infringing the same, and it is advisable to proceed against such third party, then the licensors shall allow the licensees to use the name of the licensors, and of the original inventors as parties in the action, and the parties shall defray the costs of the action and share the damages, if any, in the proportion of one-third to the licensors, and two-thirds to the licensees. In 1900, as our readers will well remember, an action against Messrs. Siemens Bros. for infringement was tried before Mr. Justice Buckley, and the hearing was subsequently carried to the Appeal Court and the House of Lords. Subsequently, Messrs. Siemens paid £3,000 into Court in respect of the inquiry as to damages, and the question was whether the plaintiffs were entitled to share in the damages, and to receive a contribution made by them to the costs of the action. In correspondence between the parties, the plaintiffs agreed to pay £250 towards the costs, but were not to be called upon to pay a further sum; and in the event of obtaining a favourable decision, out of the amount of costs and damages received, they were to be reimbursed. Defendants accepted this, but pointed out that the agreement did not in any way refer to the Court of Appeal and House of Lords. Defendants took the view that, as the case failed in the Court of first instance, the plaintiffs had lost the £250, and their interest in damages and costs had gone. Plaintiffs, however, contended that the proviso in defendants' letter merely prevented either party being under the obligation to go on with the case after the decision of the Chancery Court; but if the case went on, the costs and damages would be divided. After hearing Mr. Astbury and Mr. Shaw for the defendants, his Lordship held that the construction put on the agreement by the plaintiffs was the correct one, and that all costs must be dealt with, and the ultimate residue of the damages divided, in the way prescribed by the agreement.

Wiltshire v. National Telephone Co.—Mr. Justice Ridley and a special jury, on Tuesday, heard this action, in which the plaintiff, a dairyman, sought to recover damages for personal injury caused by the negligence of defendants' workmen. A wire which they were repairing had slacked down, and it caught plaintiff and threw him out of his cart. The jury awarded him £75.

Fatality.—On Wednesday a workman named John Hindle was painting the electric tramway standards at Heywood, when he accidentally touched a live wire; falling from the ladder a distance of 20 ft., he was instantly killed.

A High-Tension Direct-Current Railway in Vienna.—With reference to the note that appeared on p. 388 in our issue of last week under this heading, we are informed by the editor of the *Electrician* that this note originally appeared in his journal on January 12th, under a different heading, namely, "High-Tension Continuous-Current Traction in Vienna." As we mentioned last week, our abstract of Franz Krizik's paper was reproduced from a Chicago exchange—the *Railway and Engineering Review*, of February 10th; in that journal there was nothing to indicate that the matter was reprinted from any other publication, and upon examination, indeed, we find that there are important points of difference in the two notes.

Annual Supper.—The annual supper and dance of the staff of the Greenock Corporation Electricity Department was held on Thursday, 8th inst.

Institution Notes and Lectures.—Institution of Electrical Engineers.—The annual dinner in connection with the Manchester Section of the I.E.E. was held at the Midland Hotel, Manchester, on Friday evening, 2nd inst. There were present about 180 members and friends. Mr. S. L. Pearce, Chairman of the Manchester Section, presided, and amongst the guests present were the Lord Mayor of Manchester (Councillor Thewlis), the Mayor of Salford (Alderman Frankenberg), Dr. A. Hopkinson (vice-Chancellor of the Manchester University), Mr. J. Gavey, C.B. (President of the Institution), Mr. R. Kaye Gray, Mr. G. C. Lloyd, Mr. Councillor Howarth, and Messrs. S. Z. de Ferranti, Dane Sinclair, C. D. Taite, T. L. Miller, E. W. Cowan, and L. Andrews.

After the toasts of the "King and the Royal Family" had been honoured, Mr. S. Z. de Ferranti proposed the "Corporations of Manchester and Salford," and referred to the vast undertakings of the two municipalities in connection with electrical power distribution and tramways, which together had a capital in excess of four millions sterling. The undertakings were monopolies, but no monopoly was secure unless it was efficient and gave a satisfactory supply to its customers. Years ago they thought the position of the

electric tramcar was unassailable, but now the motor-'bus was to be seen in almost all the London streets. There could not, he thought, be much improvement in the electric tramways, but the motor-'bus was in its infant stage, and had everything on its side as far as improvements were concerned, and it might possibly become a serious competitor to the electric tramcar. He advised all engineers to improve and develop their undertakings, and to make them as efficient as possible, so that they could meet any competition that might arise in the future. Suction gas plants might be improved, and large consumers of power might find it cheaper than electricity at a mere fraction of a penny per unit. He thought attention should be paid to the question of obtaining power more directly from coal.

The Lord Mayor of Manchester, in reply, said it was such men as those who were present that evening who, by their endeavours, had helped to improve and make great the City of Manchester.

The Mayor of Salford also responded, and stated that he represented a borough which contained some of the oldest and largest electrical manufactories in the country. It had also one of the most efficient electrical supply stations in the country, but, unlike Manchester, all their work had been done by British manufacturers. He hoped, before long, electricity would be cheapened so that it could be used economically for heating purposes, and so do away with smoky chimneys.

Dr. A. Hopkinson submitted "The Institution of Electrical Engineers." He referred to the objects of the Association being the promotion of good feeling between its fellow members, and the interchange of knowledge. If the teaching in the universities was to be of use, it could only be attained by keeping in touch with the different practical scientific associations. There had been a great advance in electrical science since he was at college as a student, less than half a century ago. When he first heard of the invention of the telephone, he thought such a thing impossible, and did not believe it, but to-day he was ready to believe almost anything in connection with electricity.

Mr. Gavey replied on behalf of the Institution, and spoke of the high esteem in which the parent body held the Manchester Section, as regarded both membership and the high quality of the papers read, also the flourishing state of the Students' Section. He was not surprised that in a great industrial centre like Manchester the Electrical Engineers were so strongly represented. He thought that if London and Manchester were competing for the palm, those present would vote in favour of Manchester. When first he joined the electrical profession they had to find things out for themselves. The members of the Institution had received considerable hospitality from hosts in Switzerland, Italy, Germany and America. Invitations had been sent out to the various Technological Institutions in those countries for a return visit during this year. The success of the visit would be due to the co-operation of the local sections, and Manchester had already promised strong support.

Mr. R. Kaye Gray proposed "The Local Sections," and said he was greatly pleased on his first appearance at the Manchester Section. Anyone coming from London could not but be struck by the enormous potentiality of the Section. He had visited the Glasgow, Newcastle and Leeds Sections, but he thought Manchester was comparable with London.

Mr. S. L. Pearce replied, and thanked the President and Mr. Gray for their kind expressions regarding the Manchester Section. It was satisfactory to chronicle that at the last ordinary meeting they had a record attendance of 330. The President had referred to the Manchester Section being possibly in competition with London. He hesitated to say anything on the subject, but a few months ago a leaderette appeared in the Electrical Review, which referred to the papers read before the Manchester Section. The Committee tried to get together papers containing matter of a real practical character. He thought the papers read at Leeds on the lamp question, and at Manchester on "Idle Currents" would become classic literature. He appealed to all present to make the forthcoming visit of the International Electrical Congress a success in accordance with the records of the Manchester Section.

Mr. T. L. Miller proposed "Our Visitors," to which Mr. Dane Sinclair replied.

During the evening Mr. Ernest Hastings contributed some of his highly humorous selections.

"Faraday House" Old Students' Association.—The second annual dinner of the Old Students' Association was held at the Florence Restaurant on Friday last, when about 100 members and friends met to support the President, Mr. C. D. Taite, M.I.E.E., borough electrical engineer of Salford, who was in the chair. Amongst those present were Mr. Robert Hammond, the Patron; Mr. Hugh Erat Harrison, B.Sc., the Principal; Mr. Hugo Hirst, Mr. G. W. Partridge, Mr. C. P. Sparks, Mr. S. Dobson, Mr. J. S. Highfield, Mr. H. W. Kolle, Mr. A. H. Walton. A novel departure was made, no speeches being allowed, and only toasts given; the result was a decided increase in the merriment incidental to such an occasion. The dinner was followed by a musical programme which was kept going until a late hour. The menus were illustrated with views of the Hammond College and the Old and New Faraday House, and the Committee is to be congratulated upon a most successful evening.

Glasgow Insurance and Acturial Society.—Last week Mr. A. L. Taylor, M.I.E.E., electrical engineer to the Liverpool and London and Globe and Royal Insurance Co., gave a lecture on "The Modern Electrical Installation as a Fire Risk."

I.E.E. (Leeds).—A paper on "The Cost of Electricity per Unit from Private Plants" was down for reading by Mr. Wilson Hartnell at the meeting of the local section last evening.

Royal Society.—At the meeting held last night "A Discussion of Atmospheric Electric Potential Results at Kew, from Selected Days during the Seven Years 1898 to 1904," was read by Dr. C. Chree; and Mr. Dugald Clerk read a communication by the Hon. C. A. Parsons, "On the Specific Heat of, Heat Flow from, and other Phenomena of the Working Fluid in the Cylinder of the Internal Combustion Engine."

The Automobile and Cycle Engineers' Institute has made a very successful departure in the inauguration of a London section. The first meeting was held on the 14th ult., when Col. Crompton read a paper on "Some Unsolved Problems in Motor Engineering," under the chairmanship of Mr. A. E. Tucker, F.I.C., M.A.C.E.I., the president of the Institution. The meeting was very largely attended. The discussion had to be adjourned until the 7th inst., when Mr. Douglas Leechman, at whose instigation the London section has been formed, presided. There was a large number of speakers, including Profs. Sharp and Smith, and Messrs. Sturney, Clarkson, Renouf, Coventry, Cooper, Crawley and Roebuck. Col. Crompton replied to the discussion. The next meeting will probably take place on the 21st inst., when Mr. Worby Beaumont will read a paper in connection with the subject of "Public Service Motor Vehicles."

At a meeting of the Glasgow Association of Students of the Institution of Civil Engineers held on 5th inst., a paper on "Clyde Valley Electrical Power Works" was read by Mr. H. A. Barnett, A.M.I.E.E.

Mr. G. Gerald Stoney lectured on 8th inst. at Carpenters' Hall, London, on "Steam Turbines."

Annual Dinner.—The employés of the Brush Electrical Engineering Co., Ltd., Winding Department, held their fifth annual dinner on Saturday, March 10th, at the Greyhound Hotel, Loughborough, when a most enjoyable evening was spent. The chair was taken by Mr. W. Muir, head foreman, supported by his two assistants, Mr. A. Flounders and Mr. A. Ganley.

Appointment Vacant.—Switchboard attendant for Handsworth. See "Official Notices" to-day.

"Regent."—A correspondent asks whether there is an electrical firm trading under this name.

Gas.—On Tuesday, Thomas Sherlock (16) was suffocated in Grange Street, Birkenhead, by an escape of gas, and three other boys were removed to the hospital in a collapsed condition.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Engineers.—The Salford T.C., on March 7th, by 23 votes to 19, declined to adopt a recommendation to increase the salary of Mr. C. D. Taite, borough electrical engineer, from £700 to £800 per annum. Mr. Taite has been in charge of the undertaking for the last five years, and no alteration has been made in his salary during that period, though all the members of his staff have been advanced more than once. A large power department has been built up, and large plant extensions will have to be undertaken before long to keep pace with the demand. The chairman of the Electricity Committee advocated the advance in the interests of the Corporation and its Electricity Department, not on personal grounds. We have not space to spare to record all the absolute nonsense that some Councillors uttered regarding the qualifications of a chief electrical engineer (comparing the running of an electrical department with the winding of a town hall clock, and so forth)—this phase we may return to at another time. When Mr. Taite made his first report to the Council he showed a deficit of £7,000. Last year he made his fourth report and showed a profit of £11,000. The Council marks its approval of Mr. Taite's part in producing this result, by refusing the Committee's recommended advance by 24 votes to 19.

The Stockport T.C. has appointed Mr. H. Pattinson, of St. Helens, and Mr. C. H. Ward, of Leicester, as switchboard attendants at the Electricity Works, and Mr. Henry C. Allin, of St. Helens, as chief clerk in the tramways department, and has granted Mr. Carter, electrical engineer, six months' leave of absence at half pay, owing to medical treatment and complete rest being necessary.

The Swindon T.C. has increased the salary of Mr. J. G. Griffin electrical engineer, from £300 to £325 per annum, and that of Mr. T. Medcalf, traffic manager of the tramways, from £150 to £160.

The Devonport T.C., on March 8th, increased the salary of Mr. J. W. Spark, electrical engineer, from £275 to £300 per annum, and that of Mr. W. J. Stamp, assistant electrical engineer, from £140 to £150. An amendment that the recommendations should not be confirmed was rejected by 23 votes to 20.

The Crewe T.C. has increased the salary of Mr. H. H. Denton, electrical engineer, from £250 to £275 per annum.

Mr. T. S. Midgeley, of Keighley, has been appointed junior assistant electrical engineer at the Oldham Corporation Electricity Works.

Mr. H. H. Arthur, charge engineer, was presented on March 7th with a beautiful oak chiming clock, suitably inscribed, on the occasion of his marriage, by the staff of the Ilford Electricity Works, Mr. A. H. Shaw, M.I.E.E., chief electrical engineer, made the presentation.

By seven votes to six the Whitby T.C. which was recommended to increase the salary of Mr. King, electrical engineer, from £150 to £175 per annum, has decided "that the question be deferred until such time as the electrical undertaking justified an increase." The matter was the subject of a lengthy discussion, and from a report of this appearing in the local newspapers we gather that there was nothing but praise to be accorded to Mr. King for the manner in which he managed both the commercial and engineering sides of this £36,000 undertaking for £150 per annum. The Council seems to have found out that it was a mistake for so small a place as Whitby to put down its own installation, and its financial failure is made the reason for niggardly treatment of the man with whom lies no blame for the failure, but with whom undoubtedly lies whatever opportunity there may be of making it more successful. We are inclined to believe that to have given the engineer the recommended £25 additional would have been to encourage him to work still harder in the interests of the department. The Council seems to have done the best thing to lose an engineer who knows the ropes of the undertaking from the beginning, and of whom, according to many of the speeches, it thinks very highly. He was engaged, we believe, to act as resident engineer, but the duty fell upon him of also designing extensions costing £13,000, saving consulting engineering fees to the Council. For this no consideration is meted out to him. The Whitby Council would do well to reconsider the matter.

The Battersea Lighting Committee reported on Monday that Mr. W. A. Kemm, chief electrical engineer, had resigned his appointment as from March 3rd, and that they had accepted his resignation on behalf of the Council. Mr. A. P. MacAlister has been appointed acting borough electrical engineer.

The Greenock Electricity Department held their staff supper and dance on 8th inst., Mr. James A. Robertson, burgh electrical engineer, presiding over a company of 130. In responding to the toast, "The Works Staff," Mr. Robertson said that their department had made remarkable strides. There were some electrical departments that considered their duty ended when they had supplied electricity. At Greenock they had gone a step further, for they went on to the consumer's premises and assisted him as far as they were able to utilise electricity in an efficient way.

The Maidstone T.C. has decided to fix the salary of Mr. G. E. Wintle, works superintendent at the electricity works, at £100 per annum, with a bonus of £1 per quarter for each ·01d., that the works cost per unit sold is reduced below ·9d.

The Bournemouth T.C. has increased the salary of Mr. H. Godfrey Andrews, assistant borough electrical engineer, from £150 to £175 per annum, rising at the end of a year to £200.

On Wednesday the Fulham B.C. voted a gratuity of £50 to Mr. A. J. Fuller, its electrical engineer, for special services.

Tramway Officials.—The Croydon Tramways Committee recommended the B.C. on Monday night to appoint Mr. T. B. Goodyer as manager, from June 1st, at £500 per annum, subject to three months' notice on either side. The resumed discussion was as animated as any that have preceded it, and pressure was put on the Council not to delay a decision any longer, as so little time was left for making adequate arrangements for the transfer of the undertaking. Councillor Parnell moved an amendment that the managership should be vested in the borough electrical engineer (Mr. A. C. Cramb), and quoted Bolton and Cardiff as successful instances of a dual appointment of this kind. However, there was no seconder. Councillor Stranks moved that the post be advertised at £400, and this was lost by 28 votes to 17. Next, a proposal that it should be advertised at £450, was put. This was rejected by a majority of 14. Finally, the recommendation of the Committee was carried.

The Swindon T.C. has appointed Mr. Carroll as chief tramway inspector.

The third annual smoking concert of the Hull City Tramways (Electrical Engineering Department) Recreation Club was held last week. Mr. Wilkinson, the tramways electrical engineer, presided, and was supported by Mr. Robson, the assistant engineer and vice-president of the recreation club; Mr. McCombe, tramways manager; Mr. Holme, telephone manager; Mr. Bell, city electrical engineer; Mr. T. Palmer, secretary, and others. Mr. Wilkinson, in a short address, stated that the club was formed three years ago for the purpose of providing various kinds of recreation for the men employed in the engineering department of the tramways, and had for its president the Mayor. Attached to it were the annual excursion and the cycling club, and smoking concerts were held to obtain sufficient funds to provide other forms of recreation of an enjoyable and elevating character. An excellent musical programme was provided by various members of the club.

Mr. W. Jensen, the manager of the Chatham and District Light Railway Co., and his wife, have just been presented by the staff with a silver tea and coffee service and flower and fruit stand, as a mark of regard, and in celebration of their "silver wedding." Mr. Chris J. Charlton (permanent-ways engineer) made the presentation on behalf of the staff, comprising some 200 employés.

Mr. J. Owen, temporary tramway assistant at Colchester, has secured an appointment as an assistant engineer on the L.C.C. tramways.

General.—We stated last week that Mr. Weatherburn, locomotive superintendent for London district for Midland Railway Co., had been succeeded by Mr. Talbot. We understand that all the electrical work will continue to be superintended by Mr. Fox, who for a long time has been the resident engineer. Mr. Fox will now act as chief assistant to the locomotive superintendent, and will have as assistant engineers Messrs. Ransom, Kelly and Pritchard.

Mr. E. Austin has left the firm of Messrs. C. A. Parsons & Co. to take up a position with Messrs. Bruce Peebles & Co., Ltd., in Edinburgh.

In our issue of December 2nd we announced that Mr. J. B. McNamara was leaving Sheffield for Egypt. We learn that Mr. McNamara has lately been appointed to the position of chief electrical engineer to the Egyptian State Railways. His headquarters will be at Boulac, Cairo, where all trade catalogues, &c., should be addressed.

The Emperor of Austria has appointed Dr. Frederic Wagner, Chevalier de Jauregg, &c., Minister of Posts and Telegraphs. In Japan Mr. Isaburo Yamagata, Vice-Minister of the Interior, has been appointed Minister of State of Communications, vice Mr. Kanetake Oura. Mr. Ren Nakashoji, Director of Police, has been nominated Vice-Minister of Communications, in place of Mr. Kenjiro Den.

Obituary.—On 8th inst. the death occurred at Gainsborough of Mr. Henry Dickenson Marshall, one of the directors of Messrs. Marshall, Sons & Co., Ltd., of that town. The deceased gentleman and his brother took up the management of that firm about 44 years ago. At the time of his death Mr. Marshall was 66 years of age.

News has reached Dalbeattie of the death at Mabe, Seychelles, of Mr. Robert Maxwell, superintendent of the Eastern and South African Telegraph Co. Deceased, who was 54 years of age, was born in Dalbeattie, and entered the service of the Post Office there. He received an appointment at Penzance on the Eastern Telegraph Co., and he afterwards served at Gibraltar, Malta, Alexandria and Aden stations. When the Eastern and South African Co. extended their lines from Aden south, Mr. Maxwell secured the Seychelles appointment.

We regret to record the death of Mr. R. F. Yorke, M.I.E.E., which took place at Stirling on the evening of March 6th, after an illness of three weeks' duration. Reginald Frederick Yorke, second son of the late Admiral Reginald Yorke, was born at Capebrook, Herefordshire, in 1862. Educated at Marlborough College, he early showed a liking for scientific pursuits, and his bent was still more pronounced at Cooper's Hill, where, in the study of chemistry, he was the best man of his year. His first practical experience of electrical work was in the service of the Eastern Telegraph Co. at Porthcurnow, in Cornwall. Subsequently he was employed at Derby in the Midland Railways telegraphic department, under the late Mr. William Langdon, the superintendent. Here he first turned his attention to accumulators, in which he devised various improvements. He became an Associate of the Institution of Electrical Engineers in 1889, and a full member in 1898. During the greater part of his professional career he had been occupied with the application of water-power to electric lighting, and many private houses in England and Scotland, as well as the town of Fort William, bear witness to his success and skill. He took out various patents in connection with electrical development, of which the most important is his tubular system of wiring. Mr. Yorke's ability was unquestioned. He was widely known and respected in his profession as a man whose word was, indeed, as "good as his bond," and it is not too much to say that he was beloved by all who worked under him. There cannot be one jarring note in the regrets occasioned by his untimely death, nor in the sympathy which his friends must feel for those of his family and household who are left to mourn his loss.

NEW COMPANIES REGISTERED.

Films, Ltd. (87,821).—This company was registered on March 3rd, with a capital of £1,000 in £1 shares (100 deferred), to acquire the business of practical electricians, cinematograph specialists, &c., carried on at 15, Hotham Street, Liverpool, as "Andrew T. Wright & Co.," to adopt an agreement with A. T. Wright, and to carry on the said business and that of mechanical engineers, manufacturers of and dealers in electrical apparatus, conductors of cinematograph and magic-lantern entertainments, &c. The first subscribers (each with one share) are:—A. E. Birch, 14, Elstree Road, Fairfield, Liverpool, clerk; E. Brown, 2a, Brunswick Parade, Waterloo, Liverpool, cashier; J. V. Meakin, 44, Chester Street, Liverpool, clerk; J. A. Nicholson, 2, Modred Street, Liverpool, clerk; E. Barbour, 77, Brook Street, Bootle, chartered accountant; A. E. Nicholson, 14, Riversdale Road, Egremont, accountant; and R. A. Ledgard, 14, Balfour Road, Birkenhead, articled clerk. No initial public issue. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, £50; remuneration of managing director as fixed by the board; of others as fixed by the company.

A. T. Boulton & Co., Ltd. (87,799).—This company was registered on March 2nd, with a capital of £1,000 in £1 shares, to acquire the business carried on by H. Maskell, at 19, Craven Terrace, Paddington, as "A. T. Boulton & Co.," together with the lease of the said premises, and to carry on the business of electrical and mechanical engineers, art metal dealers, ironmongers, manufacturers of and dealers in electrical appliances and machinery, &c. The first subscribers (each with one share) are:—M. G. Marchant, 9, Fleur de Lis Street, E., potato salesman; O. Ruston, 73, Brushfield Street, E., potato salesman; F. W. Bick, 239, Markham Road, Walthamstow, E., potato salesman; G. F. Maskell, 42a, Caledonian Road, N., baker; H. Maskell, 19, Craven Terrace, Lancaster Gate, electrical engineer; W. L. Sandy, 90, Brayard Road, Peckham, electrical engineer; and F. W. Burnside, 30, Appilans Road, N.W., traveller. No initial public issue. Registered without articles of association. Registered office, 19, Craven Terrace, Paddington, W.

Bartitsu Light Cure Institute, Ltd. (87,817).—This company was registered on March 3rd, with a capital of £10,000 in £1 shares (2,500 6 per cent. cumulative preference), to acquire the business of the Bartitsu Light Cure and Electro-Therapeutic Institute, lately carried on at 67B, Shaftesbury Avenue, W.C., by E. W. Barton-Wright, to adopt an agreement with the said vendor, and to acquire all recipes and information as to processes, medicinal preparations and the methods of treatment appertaining to the said business. The first subscribers are:—Rev. A. E. C. Smith, Fir Grove, Sunninghill, Ascot, 50 preference shares; J. C. Partridge, 28, King Street, St. James', S.W., wine merchant, 50 preference shares; J. Beardall, 80, George Street, Hanover Square, W., solicitor, 1 preference share; E. J. Oxborrow, 2, Great Woodstock Street, Marylebone, clerk, 1 preference share; A. B. Pedley, 72, Lordship Road, Stoke Newington, N., 1 preference share; H. Whitton, "Bain View," Bainbridge, Askriggs, Yorks, farmer, 1 preference share; and E. W. Barton-Wright, 67B, Shaftesbury Avenue, W., light and electro-therapeutic specialist, 1 preference share. Minimum cash subscription, £1,000. The number of directors is not to be less than two nor more than five; the first are J. C. Partridge, E. W. Barton-Wright and the Rev. A. E. Clement-Smith. E. W. Barton-Wright is permanent managing director, without remuneration; qualification of ordinary directors, 25 shares; remuneration of ordinary directors, £50 each per annum.

Rhondda Tramways Construction Syndicate, Ltd. (87,772).—This company was registered on February 28th, with a capital of £250,000 in 2,500 shares of £100 each, to construct and equip the tramways (except those numbered 7 and 9) authorised by the Rhondda Urban District Council (Tramways, &c.) Act, 1902, and to electrify the existing horse tramway belonging to the Rhondda Urban District Council. The said Urban District Council has undertaken to grant a 42 years' lease of the tramways, when constructed, to the Rhondda Tramways Co., Ltd., at an annual rent of £2,250, which rent includes sinking fund and interest charged on about £60,000 expended, or to be expended, by the Council in connection with road widenings and improvements. This syndicate will receive from the Rhondda Tramways Co., Ltd., for the construction and equipment, debentures and shares not exceeding £450,000 (amount to be fixed after results of first year's working are known). The syndicate has entered into a contract with the National Electric Construction Co., Ltd., for the construction and equipment of the tramways, and the National Electric Construction Co., Ltd., has contracted with the Rhondda Tramways Co., Ltd., to manage the tramways for six months after they are opened for public traffic, or longer if the said tramway company so require. It is not intended to erect a generating station, but negotiations are in progress for obtaining supply in bulk. The subscribers are:—L. B. Schlesinger, 21, Cornhill, E.C., banker, 5 shares; J. C. Saunders, Milton Heath, Dorking, Surrey, insurance director, 5 shares; B. Bernheim, 4, Lansdowne Road, W., director of National Electric Construction Co., Ltd., 5 shares; J. T. Jervis, Queen Anne's Chambers, S.W., M.I.C.E., 1 share; W. B. Cownie, 22, King's Avenue, Muswell Hill, N., chartered accountant, 1 share; M. M. Keyser, 21, Cornhill, E.C., banker, 1 share; E. Morley, 25, Craven Hill Gardens, W., bank clerk, 1 share. Minimum cash subscription: The whole of the amount offered for public subscription (£243,100). The number of directors is not to be less than three nor more than seven; the first are L. B. Schlesinger, J. C. Saunders and B. Bernheim; qualification, £500: remuneration, £100 each per annum and a proportion of any surplus assets distributed on winding up. Secretary and registered office, W. B. Cownie, Queen Anne's Chambers, Westminster, S.W.

CITY NOTES.

Oxford Electric Co.

Sir Henry Mance presided at the annual meeting held on March 2nd. In moving the adoption of the report (see Electrical Review, March 2nd), he said that during the year they had added the equivalent of 7,928 8-c.p. lamps, making the total 73,000; they had added 140 new customers. The engineer and staff had been busy during the year altering the sub-stations and bringing them up to the most approved design; and the Fire Insurance Co. had reduced the premiums in consequence of the improvements. A new Babcock boiler and a Belliss-E.C.C. set had been added during the year. The company was spreading its mains north and east, and they must prudently go on and comply with the demands there; he hoped it was only a case of throwing bread upon the waters for it to return after many days. The 1,500 ordinary shares issued during the year were largely over-applied for. They had expended £8,000 more capital than they had received, and that had been found from the reserve fund which was mostly invested in the business. This was one of the principal reasons for their issuing fresh capital—they proposed to create 10,000 preference shares of £5 each, which would enable them to undertake more easily extensions which were not at first remunerative, and they could get the capital at something less than the 7 per cent. that they hoped to continue paying on the ordinary. The coal account was reduced, although the output was larger. This was due to strict economy and a lower priced coal contract than for 1904. The cost of production per unit delivered had fallen from 1·65d. to 1·47d., and the total costs had been reduced by $\frac{1}{10}$d. They would probably have to go to appeal against their new assessment. If the Oxford tramways were electrified, this company was in a position to supply current as cheaply as any tramway company could make it for themselves if they took into account capital charges.

The report was adopted, and at an extraordinary meeting which followed a resolution was passed authorising the increase of the capital to £150,000 by the creation of 10,000 5 per cent. accumulative preference shares, which should rank in priority to existing share capital both as to capital and dividend.

Brompton and Kensington Electricity Supply Co.

The meeting of this company was held on Thursday, March 8th, at Winchester House, Mr. William Page presiding in the absence of the chairman, Mr. H. R. Beeton.

In proposing the adoption of the report (see Electrical Review, March 9th), the Chairman, after referring with regret to the loss the company had sustained in the death of Mr. R. A. Germaine, who had been a director almost from the commencement of the company, said that he was pleased to be able to congratulate the shareholders upon the progress of the company during the past year. The increase in 8-c.p. lamps connected, during 1905, as compared with 1904, was 18,717, which was the largest increase in any year in the history of the company. The new business included the supply for radiators and for power purposes, and, necessarily, that had to be supplied at a very low figure. The company now had no less than 3,861 consumers connected, of whom 286 were added last year; that was an average of about 5½ new customers every week. The works costs and the total costs had been further reduced, and in both cases the previous records of the company had been beaten. The average number of lights installed by each consumer in the district was only 49; that was much below the average which consumers in the areas of other companies had installed, the houses in their district being small. That was a disadvantage to the company in one way, for the small customers caused an increase in some of the costs of the business; but, on the other hand, those conditions justified somewhat higher charges for current. The gross revenue showed an increase of £959, and the expenditure a decrease of £710, so that the net receipts for the year were £1,670 more than in the previous 12 months. The board were of opinion that those figures would be considered very satisfactory, especially bearing in mind that from general depression in trade and other causes, some of the electric lighting companies in London had shown a shrinkage in profits. Unfortunately, the success which had attended some companies in late years seemed to have provoked an evil eye on the part of some outsiders, who seemed to desire to profit out of the industry, and thus become insiders without having shared in the labours and risks of early days. The most successful of those attempts so far had come from the rating authorities, and such competition was very unfair in view of the large amount which companies like theirs contributed to the rates. Their dividend for 1905 amounted to £18,419, and apart from the King's tax and the income-tax, before that dividend could be paid no less than £2,652 had to be paid in parochial rates. Their total contributions in the year for rates and taxes had amounted to £3,860, equal to 21 per cent. of the divisible profits. In the future the charges under this head were likely to be heavier, seeing that in the quinquennial valuation just made they had had to submit to a large increase in their rateable value. It would be bad enough if they were assessed like banks, &c., on the value of the premises which they occupied, instead of being assessed on their profits, which virtually made the rates an income-tax of about 3s. in the £ in addition to the income-tax of 1s. It might be said that they could well afford to pay those taxes seeing they were paying 10 per cent., but he need not remind the shareholders that for many years they received no dividend at all. The first dividend they paid was 4 per cent., and it was only within the last two or three years that they had been able to pay 10 per cent. To fully compensate the shareholders for the barren years, it would require large dividends for a number of years, and he trusted that nothing further would be permitted to happen to prevent the shareholders reaping the benefit which was due to them for their enterprise and patience, especially bearing in mind the public utility of the undertaking. Dealing with the question of Bills in Parliament affecting their interests, he said that the Administrative County Bill in the form in which it passed Committee last year would not have injured them, as it gave the promoters no power in their area. Several Bills were being promoted this year. They would, of course, watch them closely, but it was anticipated that if one or more of them became law it would be in a form which would not materially affect their interests. They might be glad some day to take current from anyone, to meet the needs of their district if they should grow beyond the capacity of their plant, provided, of course, that they could buy a supply at a price which would answer their purpose, rather than lay down additional machinery and plant themselves. They were carrying forward the sum of £8,684. Some of the shareholders might think that was an unduly large carry over, but in view of some of the matters he had mentioned, and particularly bearing in mind that it was contemplated to still further reduce the price to consumers, the board was convinced that that was a sound policy, and in the best interests of the shareholders. As showing how they had reduced the price of current with the prosperity of the company, he might mention that in 1892 they charged 8d. per unit. Year by year that had been decreased, until last year it fell to 4·43d. per unit. They hoped this year to still further reduce the price, and they hoped it would lead to an increase in business.

Mr. W. R. Davies seconded the motion, and the report was adopted.

Newcastle and District Electric Lighting Co.

The report for 1905 states that during the year 5,533,702 units of electrical energy were sold, as compared with 3,259,389 units in the previous year, an increase of no less than 70 per cent. The profits of the Newcastle works are in excess of the previous year, and amount to £14,835 for the 12 months. The total dividend is 5 per cent. for the year, carrying forward £239. The reduced dividend is due to the increase of capital expenditure necessary to convert the company from a simple lighting concern to a complete cheap-working power company, in such a way that it may meet any competition. This extra capital did not produce revenue during the greater portion of last year, but the prospects of the company are greatly improved, and owing to certain alterations at the generating stations, whereby the cost of production will be materially decreased, it is confidently expected that, taken in combination with a large increase of business coming to the company from fresh customers, the earnings will, during the present year, be materially

enhanced. The preliminary working account of Newburn station to December 31st last, resulted in a debit of £766. The directors have thought it advisable to write this off out of reserve fund as well as interest on the capital outlay at Newburn for the year, amounting to £2,610. The expenses in connection with the debenture issue and cost of rating appeal have also been written off to reserve fund, which will then stand at £14,501. The profits of the Newcastle works for the first two months of the current year are largely in excess of the corresponding months of last year. The Newburn station is also now working at a profit.

Edwards Air Pump Syndicate, Ltd.

In their report for 1905, the directors say that the steady progress of the business may be judged from the gradual growth in the dividends paid, viz., for 1900 and 1901, 5 per cent.; 1902, 6 per cent.; 1903, 10 per cent.; 1904, 15 per cent.; while for this year the directors recommend a dividend at the rate of 20 per cent. per annum. Due care has always been taken to provide for the capital redemption fund, which now amounts to £10,000, in addition to the usual reserve funds. The income from royalties for 1905 amounted to £10,589, as compared with £9,489 for 1904, an increase of about 11½ per cent. The ordinary expenditure was £7,929, being an increase of £229, or 6 per cent. on the previous year. Both the home and foreign business of the syndicate continues to steadily expand and the royalties from foreign countries during 1905 amounted to £2,569, or 24 per cent. of the total royalty income. During the past year 1,213 pumps were booked; 691 or 57 per cent. were for land installations, and 522 or 43 per cent. for marine engines. After paying the 10 per cent. dividend, the carry forward is £262.

Perth Electric Tramways, Ltd. (Western Australia).

The directors' report for 1905 says that the gross receipts for the year amounted to £74,485, yielding a profit of £32,042, which shows a substantial increase over the corresponding figures last year, which were:—Gross receipts, £69,411; and profit, £29,360.

From January 1st to March 2nd, 1906, the receipts show an increase of £643 compared with the same period of 1905. After paying the debenture and preference interest, &c., £5,000 is added to the reserve account, and £2,500 is set aside as the first instalment of a cash reserve fund. The directors recommend a dividend of 2½ per cent. for the year on the ordinary shares, leaving a balance of £3,675 to be carried forward. During the year the construction of the 17½ miles of track authorised under the original concession was completed. The suburban concessions of Subiaco and Leederville, 4¼ miles in all, were also completed, and are now in full operation. The North Perth concession of 1 mile 13 chains remains to be constructed, and this is now being proceeded with. During the past year the construction of the Victoria Park extension has also been completed. This line is being operated under a lease, with an option to this company of acquiring the line at any time within seven years on repayment of the sum advanced (about £5,000) by the Victoria Park Council towards its construction. The favourable traffics indicate a likelihood of the option being exercised. The report of the manager and engineer (Mr. H. J. Somerset) shows that the important additions to the power plant detailed in his report for 1904 are now installed. Five new cars built locally were put in operation in January last, and should materially benefit the 1906 traffics. An attempt to inaugurate a system of motor-'buses to compete with the tramway proved a failure, and the motor-'buses have been withdrawn. The directors regret to record the death of Mr. Edward Heasman, the first chairman of the company. Mr. Allen H. P. Stoneham has been elected chairman.

British Insulated and Helsby Cables, Ltd.

The directors' report for the year ended December 31st, 1905, states that the profit for the year amounts to £133,903, to which has to be added the balance brought forward from last year £7,114, making a total of £141,017. From this have to be deducted:—

Directors' and debenture trustees' fees, and remuneration to Works' Committee, less directors' fees receivable from other companies ..	£2,577
Interest on debenture stock	22,500
Depreciation on buildings, plant, machinery, &c.	22,000
Transfer to special reserve account	8,500
Transfer to debenture stock redemption account	5,000
Dividend on preference shares to December 31st, 1905	30,000
Interim dividend on ordinary shares to June 30th, 1905	20,000
	£110,577

leaving available for dividend a balance of £30,439. The directors recommend a further dividend of 4 per cent. on the ordinary shares = £20,000, making with the interim dividend already paid a total of 8 per cent. for the year. There is carried forward to next account a balance of £10,439. During the year the volume of trade has been considerably less than in the previous year. Under these circumstances, the directors consider the result of the year's working satisfactory. A further sum of £8,500 has been added to the special reserve account. During the year only such additions have been made to the plant and machinery at the company's various works as will facilitate the business and enable its operations to be extended where possible.

City Meetings.—The annual meetings of the City of London Electric Lighting Co., the Metropolitan Electric Supply Co., and the South London Electricity Supply Corporation, have been held this week. The reports were adopted. Our account of the proceedings will appear next week.

Bournemouth and Poole Electricity Supply Co.

The directors' report for the year 1905 says that the capital expended during the year in respect of the Bournemouth Order, 1890, the Poole and Branksome Order, 1897, the Christchurch and District Order, 1899, and the Pokesdown Order, 1902, amounted to £45,193, making the total in respect of these Orders £363,488. The balance to credit of net revenue account, including the amount brought forward from last year, and after payment of all interest and other charges, reserves for depreciation and redemption fund, is £18,513. Out of this sum the full dividends on the 4½ per cent. and on the 6 per cent. preference shares have been paid, and the directors now recommend a dividend on 12,000 ordinary shares at the rate of 7 per cent. per annum for the full year ended December 31st, 1905, and on 3,000 ordinary shares paid up during the year at the same rate, less income-tax. There is then a balance of £1,706 to be carried forward.

The balance of the instalments on the ordinary shares and the debenture stock issued in December, 1904, was received during the year under review. The Wimborne prov. order granted to the company by the B. of T. was confirmed in the last Session of Parliament. The consent of the Swanage U.D.C. has been obtained to the company's application to the B. of T. for a prov. order for the lighting of Swanage. The Corporation tramways between Bournemouth and Christchurch, the current for which is supplied under contract by the company, commenced running in July last. Considerable progress has been made during the year with the scheme of wiring consumers' premises on the rental and prepayment systems introduced in 1904. The scheme applies more particularly to smaller class premises, and should materially extend the use of electric light in such premises.

The total applications received at December 31st amounted to the equivalent of 143,116 8-c.p. lamps, being an increase of 21,527 for the year, as compared with an increase for the previous year of £21,051. The total number of B. of T. units sold for lighting, power and traction purposes, was 2,005,025, being an increase of 301,696 units for the year.

The Richmond (Surrey) Electric Light and Power Co., Ltd., has made satisfactory progress during the past year. The directors of that company have declared a dividend at the rate of 7 per cent. on the ordinary shares in respect of the year ended December 31st last.

Direct Spanish Telegraph Co.

The directors' report for 1905 shows, after providing for interest on, and redemption of, debentures, a balance to the credit of revenue of £9,415. After adding the usual sum of £5,000 to the reserve fund, the balance will amount to £4,415, which, together with £795, the balance of the contingencies account, and £376 transferred from the reserve fund, enables the directors to recommend the declaration of the dividend of 10 per cent. on the preference shares, and a dividend of 4 per cent., free of income-tax, on the ordinary shares, for the year 1905, amounting to £5,586. Half of this amount was distributed on October 1st, 1905, as an interim dividend. The traffic receipts show an increase of £118 as compared with the year 1904. The ordinary working expenses show an increase over 1904 of £115.

A fault which seriously interfered with the working of the Bilbao cable was noticed on April 7th, and this was located at about 213 knots from Bilbao. The cable was cut on April 18th by the Eastern Telegraph Co.'s cable steamer *Norse*, and communication restored the next day. On October 31st the Bilbao cable became interrupted at about 29 knots from Bilbao. The repair was carried out by the Eastern Telegraph Co.'s cable steamer *John Pender* on November 9th, the interruption having lasted 10 days. The cost of these two repairs, amounting to £4,722, has been charged against the reserve fund. On December 28th a further fault was discovered in the Bilbao cable at about 12 knots from Bilbao, and although this fault did not stop communication, it was considered prudent to remove it, the work being carried out by the cable steamer *Norse* on January 7th, 1906. The cost of this repair will figure in the current year's accounts.

London United Tramways (1901), Ltd.

Mr. C. J. Cater Scott presided at the annual meeting of this company at Chiswick on Monday, March 5th. Before moving the adoption of the report (see Electrical Review, March 2nd), he congratulated Sir J. Clifton Robinson on his escape from what might have been a serious accident on the previous Thursday; briefly referred to the death of Mr. C. T. Yerkes; and mentioned the resignation of Mr. Spofford, one of their directors who had returned to the United States because the climate here did not suit him. He then turned to the accounts, with a view to showing the true position of the company. The gross receipts came to £301,350, showing an increase of £5,114, and the expenditure amounted to £175,313, being less by £874 than in the year 1904. The balance remaining as profit for 1905 was £126,036, against £120,047 in 1904, and £103,850 in 1903. The increase in 1905 was not as large as the increase in 1904, but the figures were not unsatisfactory, because there were certain circumstances which affected the traffics in 1905 which certainly told against them—for instance, the large number of wet Sundays. The weather on a Sunday might make a difference of 100 per cent. in the receipts. Although there had been a revival in the north, it had not come to London. Tramways were peculiarly the means of communication favoured by the poorer classes, and if they had fewer pennies to spend, their traffic suffered all through. Roughly speaking, their gross receipts for the first two months of this year show an increase of £1,250, while the cost of working this increase in receipts was reduced by £1,750; so that on the first two months of this year they had £3,000 to the good as compared with a year ago. Their expenditure on maintenance and repairs during the last year amounted to £33,803, which was practically the same as in 1904. But that saving in expenses would have been considerably greater but for the fact that the rates, &c., showed an increase of £2,594. On the question of the maintenance of the line, it was in excellent working order. Taking the tramways all round, their condition was not only the best, but the very best, and they need not fear comparison with any tramway system either at home or abroad. It had been said that they did not spend as much in

power their customers would eventually require from them. In- so he hoped they might have the supply for some considerable time,

maintenance per mile as certain other tramway systems; but in all these things they must make a considerable and different allowance for different circumstances, and for a new concern, such as theirs, the cost of maintenance must be less than that of older concerns, where the depreciation had been greater. He had said that the condition of the line was excellent; but there was one little exception to that—the two miles, or thereabouts, of line running from the south side of Kew Bridge to Richmond; and the reason why that line was not in good condition was that it had always been their intention to rebuild it and reconstruct it, to bring it up to the same high level of excellence as the other miles of their system, and at the same time to convert it from horse power to electric. Then, whilst doing that work, it was their intention to link it up, by the construction of a tramway over Kew Bridge, with the system on the Middlesex side. To do that they had to obtain the consent of the County Councils of Middlesex and Surrey and of the Corporation of Richmond, and he regretted to say that the terms and conditions which these two County Councils and the Corporation wished to impose were so onerous that they had to abandon the scheme for linking up. They intended, however, to take in hand the reconstruction of the line at once, and convert it to electricity, and hoped that later on they might be able to make satisfactory terms with the two County Councils and the Corporation of Richmond, and that they would be able to run right to the centre of Richmond. As soon as they proposed to give an official tramway service, all the local authorities were up in arms and trying to squeeze them in some way. The revenue account showed a balance available for the ordinary shares of £29,884, which, if they had distributed it all, would have been equal to more than 4 per cent. for the year, and this was after having about £500,000 invested in new extensions which were not, at the date of the report, in operation. Further, there was a very large amount of capital invested in new extensions which were opened some little time back, which could not be said yet to be producing anything like the maximum revenue which they might expect. The company was in what he might call the construction stage, and it was somewhat unusual for any company, during the construction stage, to start a reserve. Still, it was their desire to be absolutely conservative in all matters of finance, and to make the financial position of the company as strong as possible, and therefore, although possibly some people might say it was not necessary to start a reserve yet, they felt it was their duty to do this, and so strengthen the position of their debenture holders and preference holders to the utmost of their power. It was not every company that could do that, but they were in a happier position. They were in this very happy position—that the Underground Electric Railways Co. of London held over five-sixths of the ordinary share capital of the London United Tramways, and the Underground Electric Railways Co. thought that, in their own interests, the best thing they could do was to strengthen the company in every way, and they were perfectly ready to suffer some loss in immediate revenue for the sake of putting the company in a strong position in the future. They had every confidence that the company would be able to make good to them that loss of dividend which they were now suffering. As showing the confidence of that large company in the London United Tramways, since they acquired this large amount of the share capital of this company, they had expended, and would expend before the lines which were now constructing were finished, something like £500,000 in addition to the amount which they paid for the shares. A good many people thought that they were not making sufficient provision for depreciation. It had always been his policy, in every company with which he was connected, to see that depreciation was looked after; but it was necessary to give a very short explanation. Their capital cost included not only the cost of the tramways, with their equipment, and a hundred and one things necessary to the working of tramways, but also the cost of the extensive street widenings and improvements, the burden of which had been put upon them by the various local authorities with which they had come into contact. The London County Council tramways were perhaps those with which they had most in comparison; and the London County Council, he believed, in dealing with these street improvements and widenings, charged one-third only to the tramway undertaking, one-third was paid by the local authority where the tramways ran, and the balance of one-third was contributed by the County of London generally, so that, in the case of the London County Council Tramways, only one-third of the necessary expenditure for street widenings was carried by the tramways themselves. Of course, this company had no local authority and no County of London to take any of the burden from their shoulders, so that the whole of those street widenings and improvements fell on the tramways, and it was therefore impossible to make any fair comparisons of the cost per mile of their system with that of practically any other body. When they had completed the works which they had in contemplation they would have about 55 miles of tramways in operation. Of that about 30 per cent. could be acquired by various local authorities on what were generally called "Tramway Act Terms," the remaining 70 per cent. being acquirable on what were called "going concern" terms. If they took the average life of those 55 miles—that was the average time which must elapse before the local authorities had power to acquire that system—it amounted to about 20 years. When a local authority desired to take over their tramways, of course the price had to be settled by arbitration; but they were advised by their legal friends that the cost of widening and street improvements incidental to the construction of the tramways would be recouped to the company. It, therefore, followed that, so far as the amount representing street widenings was concerned, there could be no depreciation, although, of course, the burden of interest on the cost of those street widenings had to be carried by the company. Coming to the question of the tramways proper, there, of course, year by year there must be depreciation, and that depreciation ought to be met in the first place by maintaining the tramways in a high state of efficiency. But that was not quite sufficient, because they knew when they went before the arbitrators who had to settle the value to be paid, there was always an element of uncertainty; nobody could tell what the amount awarded would be, and therefore, as prudent men, they thought it was wise to build up some provision, so that the price eventually paid to them with the reserve, should be sufficient to return the money to their shareholders. That was a sound policy, and it was the standard they were setting before them. They hoped that as time progressed, and the income of the London United Tramways became larger and larger, they would be able to add to that reserve fund such sums as would assure their future. Last year they had 37 miles in operation and 9 miles in construction. On Thursday last of those 9 miles they opened 7 to traffic through Kingston, Surbiton, and that neighbourhood, making 44 miles in operation. But now they were taking in hand something like 8 miles more, which would link up the eastern end of their Surrey group of Kingston and Surbiton, passing on from Wimbledon to the London County Council tramways system at Tooting. When they had done that they would have 55 miles in operation, and they hoped that for the present their construction would stop and their capital account be closed. Then, when they had these 55 miles in operation, they would have linked up Hammersmith, Shepherd's Bush, Uxbridge, Ealing, and the Thames Valley right round to Wimbledon and Tooting, with the enormous population in the South of London, and it was not possible for anyone to contemplate what that meant without feeling that there was a very fine prospect indeed for the London United Tramways.

The report was adopted after a few questions had been put and satisfactorily answered. The retiring directors and auditors were re-elected, and an extraordinary meeting followed, when the company's Bill for this session was briefly explained and approved.

South Wales Electric Power Distribution Co.

Mr. Robert Forrest, D.L., presided at the annual meeting held at Cardiff last Friday. In moving the adoption of the report (see Electrical Review, March 9th, p. 396), he referred (according to the *Western Mail*, from which the following remarks are extracted) to the difficulties that they had had to contend with in starting and developing the undertaking. Their troubles were not yet at an end. Although the directors were business men, they had to rely in a considerable measure upon their official advisers, and he was afraid rather a sanguine view had been taken of the early prospects of the company, and by that he meant the rapidity with which their customers could couple up their colliery plant with the mains. Under advice considerable sums of money had been expended on buildings, plant, machinery, and mains which had not yet, and which would not for some little time, become productive to the extent that the directors had hoped. At Pontypridd they had a very large station, capable of accommodating some 20,000 H.P., of which only 7,500 H.P. had up to the present been installed, and for this reason only a small proportion of the plant was required to deal with the load at present existing. It would probably have been better if the company had begun in a smaller way, but these arrangements were made and contracts entered into when the company took over the undertaking from the limited company. Having put forward the somewhat dark side of the picture and explained why their expectations of a good return on their outlay were not realised as early as anticipated, he thought he might safely say that the other side of the picture was much brighter. Some important changes had taken place in the management and working of the undertaking. The former general manager had resigned his position, and the engineers to the company from its inception had also resigned. The directors had been very fortunate in securing the services of Mr. W. A. Chamen, of Glasgow. Mr. Chamen had taken up the position of engineer and general manager to the company, and would devote the whole of his time and energies to the affairs of the company. As to the future prospects of the company the directors were as firmly convinced as ever that the demand for electrical power in the district existed, and they believed they would get the business, but the change over from steam was a gradual process. He referred at the last general meeting to the contract for the supply of one of the largest collieries in the district, the negotiations for which had taken so long. It was anticipated that the supply to these collieries would have commenced in September last, but, as a fact, the company had only within the last fortnight commenced to take current. The negotiations were begun in May, 1904, and the agreement completed in February, 1906, so that the shareholders would see that a year and ten months had elapsed between the opening of the negotiations and the actual commencement of supply. The same kind of thing had occurred with other collieries in the district. The mains were laid, the sub-station built and equipped, and the electrical pressure put on in readiness for supply in October last, but up to the present time only a very small quantity of electricity had been taken, in consequence of the backward state of the colliery companies' electrical equipment. These were two typical instances of the trouble from which the company was suffering. He referred at the last meeting to the very gratifying feature that in practically every instance where a supply of power had been taken from the company their customers, after a short trial, had proceeded to extend their electrical plant. He was pleased to say that during the past twelve months this had been fully confirmed, that where there was room for extensions—and in the large collieries and works this was invariably the case—these extensions were taking place, and in most instances the company had only touched the fringe of the

power their customers would eventually require from them. Inquiries for power were coming in from practically all parts of the area to which the company's Act extended, and the directors regretted that they were unable to entertain at present some of the applications, as they did not feel justified in incurring the expenditure necessary to give the supply. The directors thought that, as far as practicable, their policy should be to foster and develop the custom within reach of their existing mains, and to avoid as far as might be, without injury to their prospects, all expenditure to serve custom which, although it would, probably, develop and give an adequate return on the capital, could not immediately justify the expenditure. Since the last meeting Sir William Thomas Lewis, Mr. E. P. Martin, and Mr. J. Weston-Stevens had resigned their seats on the board.

Sir R. H. Sankey seconded, and the motion was adopted.

County of London Electric Supply Co.

Mr. J. B. Braithwaite presided at the annual meeting held at Winchester House on Monday, and in moving the adoption of the report (see Electrical Review, March 9th) he said he thought shareholders would consider it satisfactory that the board were able to show a considerably increased revenue and a slightly increased dividend, as he foreshadowed at the last meeting. On the debit side of the balance-sheet there was practically no change this year. The assets side was increased by the capital expenditure for the year, which expenditure was after making the reduction in the reserve for depreciation account of £7,559, the ascertained figure for writing off the small units which were installed at the inception, and had since been scrapped. The gross revenue was £146,014, against £135,790, an increase of £10,224. That increase was obtained in face of the reduction they had been making in the price to customers. In the autumn they made a further reduction in price, the full effect of which would be shown this year. He did not anticipate they would have to make any further substantial reduction in the immediate future. The increased gross revenue of £10,224 was earned at an increase of expenditure, so far as the generating station was concerned, of only £654, so that of the gross increase they secured £9,570 as net. That bore eloquent testimony to the skill and efficiency of their technical staff. As a matter of fact, they actually secured the extra revenue with a reduction of about £23 in the cost of their coal. Altogether out of revenue this year they were putting £4,555 more to their various depreciation and suspense accounts than in the previous year, and after doing that they were still in the position to give the shareholders an extra ½ per cent. dividend, making 5 per cent. for the year. They were placing £24,550 out of revenue to depreciation, reserve and suspense accounts, so that they were not starving the suspense accounts in order to pay the larger dividend. He hoped that as sales increased the amount thus set aside would steadily increase with them. With regard to the item "Units unaccounted for," the quantity so expended represented 22½ per cent. of the amount generated; and in view of the exceedingly wide and scattered character of the company's district, especially south of the Thames, he thought that was a figure they had reason to be satisfied with. He was not aware of any other company with an equally scattered area, that was doing it so economically. Capital expenditure during the year had been almost exactly the same as in the previous year, when it was £50,000 less than in the year before. In 1904 the amount of capital expenditure on mains was 68 per cent. of the total, and for this year it was almost exactly the same; that was still the main head under which they had to make expenditure. Much of the company's district on the southern side of the river was being built upon; new districts were being opened up, and in those cases many of the builders invited the company to put in their mains, they themselves wiring the houses for electricity. Although that capital expenditure was unproductive for the moment, to a large extent, they would be acting unwisely if they did not avail themselves of laying these mains while the new roads were being made, and sooner or later he believed the expenditure would become thoroughly productive. Then in the past year they had been extending their generating plant. He told them last year that they were going to use turbine plant at their stations, and during the year under review the first two 1,500-kw. "Curtis" turbines had been delivered and were now at work, with results so far satisfactory that they had ordered additional turbines, which he thought would equip them with generating plant for a considerable time to come. The total cost, as compared with the revenue this year, had fallen slightly. Last year they were 45·3 of the revenue, and this year they were 44, in spite of the reduction in price. They had spent during the year £82,380 on capital account, and the net increase in the revenue secured was £9,570, which worked out at 11½ per cent. on the capital expenditure. The progress of the company, as measured by the units sold, was almost exactly the same as in 1904. Last year they sold 1,426,000 extra units, and this year 1,432,000. In actual lamp connections, 1904 was a record year, but this year they had succeeded in improving on that. Last year they increased to an equivalent of 118,000 8-c.p. lamps and this year to an equivalent of 122,900 8-c.p. lamps, this being the largest increase of any London company, and he hoped that was a feature which would continue. For 1996, up to the present, they had an increase of 40 per cent. upon the corresponding period of last year. With regard to motive power they had 10,000 h.p. practically on their mains at the present time. They had increased by 2,121 h.p. during the year, and had other large customers in prospect. The company was supplying power for the new shallow tramway of the L.C.C. from Aldwych to Islington, and they were doing this at a price at which the Council could not generate it for themselves, so he hoped they might have the supply for some considerable time, though at present the contract was only for 12 months. Shareholders ought not to be unduly alarmed at the number of power Bills which were coming forward. In their original form, no doubt, they were a serious menace to electrical companies, because it was contemplated that they would supply their customers direct, but since then he thought the equity of the company's position had been recognised, for in most cases leave was now only being sought to supply power in bulk, and it was no disadvantage whatever to the companies to have people who were prepared to supply them in bulk, because they need not take it unless it were offered on cheaper terms than they could generate it at themselves. During the year they had had an increase of nearly 2,000 in the number of customers, and on the whole the outlook was fairly encouraging. In order to provide for capital expenditure, it was proposed to make almost immediately an issue of the remaining 10,000 of their 6 per cent. cumulative preference shares at £12 a share.

The report was adopted, and the retiring directors and auditors were re-elected. A vote of thanks to the board and staff closed the meeting.

Prospectuses.—*Langkon North Borneo Rubber, Ltd.*—This company has been before the public (the list was to close yesterday) with an issue of 85,000 £1 shares, upon which a dividend of 4 per cent. is unconditionally guaranteed for six years by the British North Borneo Co. It is intended to begin rubber plantation at once on an area of 2,500 acres out of a total concession of 12,000 acres in Maradu Bay.

Perak Rubber Plantations, Ltd.—An issue of 75,000 shares of £1 each has been offered for subscription this week. The company will acquire and develop the Sungei Krudda Estate, Perak. The estate is said to be already producing rubber in considerable quantity.

County of London Electric Supply Co.—This company has this week offered to the public an issue of 10,000 6 per cent. cumulative preference shares (£10) at £12 each.

South Metropolitan Electric Light and Power Co.—The transfer register for the 4½ per cent. mortgage debenture stock will be closed from March 20th to 31st, both days inclusive, for the preparation of interest warrants.

Widnes and Runcorn Transporter Bridge Co.—The report shows a profit of £112 earned from October to December 31st, 1905.

Davis & Timmins.—The report for 1905 shows a net profit, including £4,084 brought forward and after allowing for depreciation and commission to manager, of £14,413. The directors recommend a dividend of 8 per cent. for the year on the ordinary shares, placing £2,000 to general reserve and carrying forward £5,053. The board is increasing the capacity of the Wood Green factory, and considerable progress has been made with the work. The annual meeting was held on Wednesday, Sir Henry Mance presiding.

Cork Electric Tramways and Lighting Co.—The report for 1905 shows receipts £47,360, and expenses £29,381. A sum of £1,500 has been added to reserve for depreciation and insurance, £448 has been written off for plant on loan, &c., and the directors recommend a 5 per cent. dividend on the ordinary shares, carrying forward £996. The lighting and power business continues to show progress, 187 additional consumers having been connected up during the year. A contract has been entered into for the supply of current for lighting purposes to the Cork Military Barracks. Traffic receipts show an increase of £694. The capital expenditure during the year was £3,647, expended mainly on house services and cables. The annual meeting was held in London yesterday.

Marconi's Wireless Telegraph Co.—The directors announce that they have conditionally allotted to the shareholders in proportion to their holdings, 128,063 shares of £1 each, at the rate of one new share for every two shares held at the price of £1 per share.

Hadfield's Steel Foundry Co.—For the past year, after paying 22½ per cent. dividend and bonus (as already announced), and placing £10,000 to reserve and renewal account, £15,788 remains to be carried forward. The growing nature of the business has rendered it desirable to extend the East Heckla works, and for this purpose it is proposed to increase the preference capital by an issue of 4½ per cent. preference shares.

Rosario Electric Co.—The company has decided to pay dividends on the 6 per cent. preference shares for the half-year ended December 31st, 1905.

Stock Exchange Notices.—The Committee has appointed Wednesday, March 21st, to be special settling day in:—

Sir Hiram Maxim Electrical Co., Ltd.—7,362 6 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 7,362.

And has ordered the undermentioned to be quoted in the official list:—

American Telephone and Telegraph Co.—$53,000,000 Collateral Trust 4 per cent. bonds of $1,000 each, Nos. 1 to 28,000 and 53,001 to 78,000.

Havana Electric Railway Co.—The directors have declared a quarterly dividend of 1 per cent. on the preferred stock.

British Columbia Electric Railway Co.—Numbers are announced of 60 4½ per cent. first mortgage debentures, each for £40 (nominal value) which have been drawn for redemption.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Route miles open. *
Aberdeen	Mar. 11	2,228	+ 30	41	55,524	— 811	..	..
Ayr	,, 3	359	+ 10	41	12,170	— 79	8	..
Bath	,, 10	1,352	+ 318	10	6,344	+ 1,045	13	..
Belfast	,, 9	5,809	+1,408	10	28,930	+ 6,807	40	+ 6½
Birkenhead	,, 11	1,992	+ 94	49	50,504	— 515	13·5	..
Blackburn	,, 7	1,754	+ 260	49½	47,297	+ 2,617	13·75	..
Blackpool Corp.	,, 8	664	+ 49	49	48,559	+ 2,073	11·87	..
,, —Fleetw'd	,, 10	421	+ 25	10	1,832	— 9	..	..
,, —Lytham	,, 8	317	+ 32	18	2,722	+ 286	7½	..
Bolton	,, 11	3,760	+ 407	50	95,252	+ 5,071	26	+ 1
Bournemouth	,, 7	2,671	+ 855	48½	68,627	+16,299	17·4	+ 7½
Bradford	,, 10	8,152	+ 667	49	212,096	— 1,911	53	..
Brighton	,, 11	1,494	+ 14	50	48,153	..	9·5	..
Bristol	,, 9	9,761	+ 700	..	..	..	28·5	..
Brit. Elec. Trac. Co								
Airdrie	Mar. 3	420	+ 51	9	1,905	+ 196	8·5	..
Barrow	,, 3	401	+ 30	,,	1,729	+ 157	5·37	..
‡Birmingham (City)	,, 3	10,888	— 317	,,	44,935	— 899	14·5	..
Birmingham (Mid.)	,, 3	2,739	— 696	,,	11,708	— 2,588	12·25	..
Devonport	,, 3	765	— 35	,,	3,516	— 214	8·85	..
Dudley—Sto'rb'ge	,, 3	1,503	+ 66	,,	6,449	+ 326	21·25	..
Gateshead	,, 3	1,820	+ 73	,,	7,965	+ 435	11·25	..
Gravesend, N'fleet	,, 3	586	+ 17	,,	1,690	+ 91	6·5	..
Greenock	,, 3	1,133	+ 93	,,	4,920	+ 424	7·25	..
Hartlepool	,, 3	495	+ 12	,,	2,187	+ 112	6·72	..
Leamington	,, 3	266	+ 104	,,	1,121	+ 349	..	..
Merthyr	,, 3	345	— 5	,,	1,491	— 16	2·9	..
‡Metropolitan	,, 3	5,402	+1,766	,,	23,623	+ 7,304	..	..
Middleton	,, 3	562	+ 60	,,	2,402	+ 184	8·5	..
Oldham — Ashton	,, 3	1,013	+ 59	,,	4,378	+ 202	9·13	..
Peterborough	,, 3	186	— 11	,,	829	— 37	5·31	..
Potteries	,, 3	3,471	+ 264	,,	15,033	+ 982	29	..
Rothesay	,, 3	84	— 6	,,	427	+ 37	2·75	..
Southport	,, 3	467	— 3	,,	2,016	+ 39	8·17	..
South Staffs.	,, 3	1,542	+ 261	,,	6,636	+ 1,116	13·87	..
Swansea	,, 3	1,402	+ 504	,,	6,180	+ 2,263	5·5	..
Tynemouth	,, 3	312	— 17	,,	1,380	— 74	3·75	..
Weston-s-Mare	Feb. 28	56	+ 4	,,	223	— 4	3	..
Wolverhampton D.	Mar. 2	784	+ 99	,,	3,221	+ 290	14·75	..
‡Worcester	,, 2	446	— 38	,,	2,034	— 118	5·75	..
Yorks. Wool. Dist.	,, 2	1,607	+ 523	,,	7,019	+ 2,419	17	..
Miscellaneous	Feb. 16	898	— 60	,,	3,015	— 38	..	..
Burnley	Mar. 10	2,173	+ 285	..	..	..	7·5	..
Burton-on-Trent	,, 11	543	— 61	49	14,911	..	8·5	..
Bury	,, 4	1,604	..	48	36,593	..	10·5	..
Cardiff	,, 3	3,693	— 233	48	97,337	+ 298	15·8	..
Carlisle	,, 10	305	+ 27	10	1,563	+ 134	..	..
Chatham and Dist.	,, 8	1,160	+ 16	10	5,530	— 40	9·3	+ 8
Cheltenham	..	..	..	..	..	..	..	..
Colchester	,, 7	327	— 5	31	5,660	..	7½	+ ½
Cork	,, 8	852	+ 43	10	3,961	+ 5	9·9	..
Coventry	Dec. 14	815	+ 8	50	28,960	+ 642	9·89	..
Darlington	Mar. 10	388	+ 27	49	9,920	..	4·87	..
Darwen	,, 9	458	+ 53	49	11,844	+ 756	4·34	..
Dover	,, 11	365	+ 33	49	10,804	+ 103	4·75	+ 1½
Dublin	,, 9	9,115	+ 421	10	44,278	+ 1,672	48·5	+ ·5
Dundee	,, 7	1,868	+ 391	42	39,624	+ 3,624	12·5	..
East Ham	,, 10	1,680	+ 297	49	40,469	+ 5,815	8	+ ½
Exeter	,, 9	452	..	49	13,546	..	4·25	..
Glasgow	,, 10	30,497	+2,505	40	622,991	+41,412	78	+ 5·5
†Gloucester	Feb. 21	221	+ 12	..	..	..	15	..
Halifax	Mar. 7	2,655	+ 285	49	75,482	+ 5,600	37	+ 1·5
Hastings	,, 9	733	..	..	..	..	..	..
Huddersfield	,, 10	2,707	+ 300	49	66,735	+ 3,985	28	..
Hull	,, 10	4,320	+ 90	49	109,117	+ 2,229	13	..
Ilford	,, 10	850	+ 142	49	22,678	+ 1,124	..	..
Ilkeston	,, 7	226	+ 19	49	5,726	— 662	3·5	..
Ipswich	,, 10	673	+ 27	49	20,406	— 1,870	10·5	..
Isle of Thanet	,, 10	539	+ 54	10	2,341	+ 55	..	..
Kilmarnock	,, 10	276	— 1	43	6,663	..	4·12	..
Kirkcaldy	,, 7	384	— 5	..	..	..	7·5	..
Lan'kshire Trm. Co.	,, 8	1,584	+ 303	10	8,141	+ 1,866	12·5	+ 3·9
Leeds	,, 3	11,167	+ 611	49	286,777	+ 9,187	89·5	+ 8
Leicester	,, 10	4,217	+ 417	10	19,828	+ 2,639	..	..
†Leith	,, 3	407	+ 201	41	15,278	..	6	+ 1
Liverpool	,, 3	20,293	+1,078	9	90,565	+ 3,560	104	+ 1
L.C.C.	Feb. 24	27,013	+2,045	47	688,727	+90,024	52·5	+ 7·8
Lowestoft	Mar. 10	215	— 14	24	3,145	— 56	3·5	..
Manchester	,, 10	25,228	+2,210	49	628,629	+33,086	..	..
Nelson	..	..	..	..	..	..	..	..
†Newcastle	,, 3	3,585	+ 5	48	182,271	+ 4,414	..	..
Newport	,, 3	1,071	+ 118	22	12,005	+ 946	14·5	+ 1·5
†Northampton	,, 9	390	+ 39	49	20,633	+ 5,318	5·5	..
Oldham	,, 11	3,155	+ 425	50	81,147	+18,092	23·75	+ 1·6
Pontypridd	,, 10	30 7	..	49	7,815	..	3·5	..
Portsmouth	,, 10	2,950	+ 165	49	93,088	+ 1,870	14·5	..
Preston	,, 7	1,204	+ 111	..	..	..	..	..
Reading	Feb. 22	1,072	+ 18	47	29,267	— 498	..	..
Rochdale	Mar. 10	1,612	+ 7·8	49	38,406	+24,974	21·3	+ 5·8
Rotherham	,, 8	570	+ 91	49	22,217	— 19	9·3	..
Salford	,, 5	8,187	+ 809	49	207,764	+12,362	..	..
Sheffield	,, 11	9,855	+ 877	50	246,767	+15,079	35·75	-1·5
Southampton	,, 7	1,706	+ 168	22	19,427	+ 187	..	..
Southend-on-Sea	,, 7	497	+ 62	49	17,684	+ 1,103	6	..
Stalyb'dge, Hyde, &c.	,, 3	1,162	+ 316	48	30,337	..	21	..
Stockport	,, 9	1,604	+ 748	49	37,382	+10,993	15·5	+ 4
Sunderland	,, 11	2,440	+ 218	49	64,336	+ 3,056	..	..
Swindon	,, 7	329	+ 22	49	9,419	..	4·4	..
Tyneside	Feb. 28	714	+ 44	9	2,899	+ 88	8·87	..
†Warrington	,, 22	389	+ 50	47	16,074	+ 1,064	6·37	+ ·25
West Ham	Mar. 8	4,021	+1,858	48	90,372	+39,020	14·7	+ 4·9
†Wolverhampton	Feb. 28	716	..	..	..	..	10	..
Yorks. W. Riding	Mar. 11	1,509	+ 404	10	6,712	..	..	..
Cen. London Rly.	,, 10	13,927	— 492	10	69,692	— 2,366	6	..
City & S. Lon. Rly.	,, 11	5,740	+ 229	10	29,923	— 40	6·25	..
Dublin-Lucan Rly.	,, 9	182	..	10	851	— 70	7	..
G. N. and City Rly.	,, 10	3,701	+ 194	10	18,173	+ 510	3·5	..
L'pool Overh'd Rly.	,, 11	2,794	— 95	10	13,892	— 746	6·65	..
Mersey Railway	,, 10	3,373	+ 255	10	16,954	+ 754	4·5	..
Metropolitan Rly.	,, 11	33,195	— 604	10	168,082	— 1,848	70·5	..
Met. District Rly.	,, 11	16,212	+ 684	10	81,385	+ 4,345	24	..
Anglo-Argentine	,, 11	30,710	+3,703	10	147,690	+15,625	..	..
§Auckland	Feb.	9,744	+ 340	9	21,708	+ 828	18·64	..
§Brisbane	,,	9,773	+ 83	..	..	..	..	..
§Brit. Columbia Rly.	Jan.	19,993	+3,493	30½	143,203	+31,050	..	..
†Bu'n's A'r's E.T. Co.	Feb. 3	1,384	+ 256	5	6,951	+ 1,584	..	..
Bu'n's A'r's-Belgr'no	Mar. 11	7,276	+ 651	10	35,110	+ 3,332	..	..
†Calcutta	,, 3	2,848	— 57	..	..	..	..	..
§Cape Electric T. Co.	Jan.	13,306	..	..	..	..	..	..
§Geneva	,,	7,679	..	..	..	..	..	..
§Mexico	,,	61,820	..	..	..	..	..	..
Perth (W.A.)	Mar. 9	3,083	+ 96	10	15,453	+ 684	24·25	+ 5½

* Compared with the corresponding period of 1905. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Wednesday Evening.

Upon the Conference at Algeciras the business of the Stock Exchange is now pendant. One day the affairs look as though they would straighten out, and prices immediately improve with an accession of orders; then there comes news read in a less satisfactory light, and trade falls off in a remarkable manner. A settlement of the various questions is now ardently desired; whether it be conclusive or not, the Stock Exchange contends that the Conference should end, if business is to improve. Money, for the time being, has taken a secondary place in the features of finance.

Some kind of settlement is also sighed for in connection with the various London power schemes. Those, however, everyone recognises cannot be considered in a day, a week, or a month. Even the prospect of a Royal Commission might have been viewed with a certain degree of favour now; it would at least have relieved the market from the chance of London County Council interference with the supply companies for some long time to come. And it is the L.C.C. which the financial authorities dislike so much, the other power proposals being regarded as quite innocuous compared with the harm that the Council's Bill might work upon the present undertakings. This opinion we reflect merely as being one drawn from the market. Private investors may, of course, regard the matter in other lights.

Foreshadowed here a fortnight back, the new County of London Preference issue is out this week, and the existing Preference fell 5s. to 12⅜ upon the emission. At the price of 12, the shares, of course, pay exactly 5 per cent. on the money, not a bad yield for a sound Industrial Preference share, where the interest appears secure enough. Despite this, however, the investor may perhaps think there are more attractive channels for his capital, and he may not be far wrong.

"And one man in his time plays many parts," as Jaques says, in "As You Like It." Mr. J. B. Braithwaite is chairman of the County of London Electric, a director of the Electric and General Investment (which is guaranteeing the new County issue) and a member of the firm who are stockbrokers to the County of London Co.

Many of the electricity supply shares were quoted *ex* dividend on the last Stock Exchange pay-day. The deductions are mostly represented by falls that have occurred in the quotations. Westminsters are weak at 10, *ex* the 6s. 6d. dividend, the price showing a fall of 10s. Chelseas have recovered $\frac{1}{16}$ of the distribution, while Charing Cross Ordinary are ¼ harder at 5¼. St. James' have improved a little to 9⅜. No change took place in Metropolitans after Tuesday's meeting, at which the chairman pointed out the favourable position occupied by the undertaking in the contest for the supply of electricity in bulk. The Bournemouth and Poole report is a good one, and its extensive advertisement in the papers might create a thought in the suspicious mind that no surprise would be felt if a new issue were to be made before long. The price of the Ordinary is 12⅜, of the First Preference 10¼, and the Second Preference 11½. The Oxford Co. will soon be offering 5 per cent. Preference shares to its proprietors, and the new issue of Adelaide 6 per cent. Preference comes shortly.

Strong speculative buying rushed Anglo-American Telegraph Deferred to a fraction over 20, and the stock shows a handsome rise on the week, while the Ordinary and Preferred are both ½ better. Continental buyers are helping the rise. Otherwise, telegraph securities have little animation calling for comment. Marconis are *ex* rights, and down ⅛ to 1⅛. The *ex* rights was rather an empty compliment, because the premium on the new shares is about 4½d. Eastern Extensions are ¼ harder at 15¼, and Eastern Preference lost a point. Neither of the Globe shares have altered, but Submarine Cables Trust rose 1 per cent., the buying still emanating from New York.

National Telephone stocks move erratically. The Preferred, *ex* 3 per cent., is down 4, but the Deferred has risen 1 to 112½, although it is *ex* 2½. First and second Preferences were marked down 10s. upon the deduction of the 6s. dividend, and the ¼ fall in third Preference equals the amount of the distribution. No other fluctuation has taken place in telephone descriptions.

Support has at last been accorded to British Electric Traction shares, and the Ordinary are being done at 7 and a trifle over. The Second Debenture fell ½. Railway and Traction issues are quiet, none of the electrical railway stocks showing any move. Districts are 30 and Metropolitan 79½, while the opening of the Baker Street and Waterloo Railway formed a fine opportunity for mentioning the prices of the shares in the newspapers, shares that until lately were all but unmarketable unless you happened to be a buyer. The company's 4 per cent. Debenture stock stands at 101, and the shares are 8¼. Anglo-Argentine Tramway Ordinary at 9 are a shade better.

Of the Manufacturing shares, General Electric Preference have improved to 9⅝, and Babcock also went better to 4⅛. Brush Ordinary rose to ⅞. India-Rubbers are 10s. lower at 18, and Telegraph Constructions look rather cheaper at 33½ *ex* the dividend of 24s. Henley's at 13 display the exact amount of the dividend deducted.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations March 7th.	Closing Quotations March 14th.	Business done week ended March 14th, 1906. Highest	Lowest.	Rise + or Fall —
17,700	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	4 %	98½–101½	98½–101½	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	3¾– 4¼	3¾– 4¼	..	..	..
155,600£	Do. do. 5 % Debs., Nos. 1 to 1,350 Red.	100	Nil	Nil	Nil	5 %	83 – 88	83 – 88	..	..	..
702,600	Anglo-American Telegraph	Stock	60/6	61s.	2³⁄₁₆%	3¼%	65 – 67	65¼ – 67½	66	65¾	+ ⅛
3,148,700	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5¹⁵⁄₁₆%	6 %	113 –114	113¾ –114¾	114¼	113¼	..
3,148,700	Do. do. do. Deferred	Stock	1/-	2s.	Nil	1⁹⁄₁₆%	18½– 19	20⅛– 20⅝	20⅛	18¹⁵⁄₁₆	+1⅛
50,000	Anglo-Portuguese Tel., 5% Mort. Deb. Stock Red.	100	..	..	..	..	103 –105	103 –105	..	..	..
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	8 – 8¼	8 – 8¼	..	..	..
1,932,856£	Commercial Cable Stng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	4 %	97½ – 98⅝	97⅞ – 98⅛	..	..	..
16,000	Cuba Telegraph	10	6¾%	10 %	5 %	5 %	8¾– 9	8¾– 9	..	..	..
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	10 %	17 – 18	17 – 18	17½	..	..
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅜– 3⅝	3⅜– 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8¾– 9	8¾– 9	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	100 –103 %	100 –103	..	..	..
60,710£	Direct United States Cable	20	3½%	3 %	3½%	3⅝%	15½– 15⅞	15½– 15⅞	15⅝	15⅝	..
70,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	99¾–101½	99¾–101½	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	5 ⅝%	147 –150	147 –150	149	147½	..
2,000,000	Do. 3½ % Pref. Stock	100	3½%	3½%	3½%	3½⅝%	91 – 93	90 – 92	92	91¼	–1
1,848,772	Do. do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	4 ⅝%	107½–109½	107½–109½	108⅜	108	..
800,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	6 ⅝%	14⅝– 15¼	15 – 15½	15½	15	+ ⅛
752,400	Do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 ⅝%	105 – 107	105 –107	106½	106¼	..
500,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	4 %	99 –101	99 –101	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	101 –103 %	101 –103	..	..	..
180,887	Globe Telegraph and Trust	10	£3	5½%	5⅝%	5 %	11¼– 11⅝	11¼– 11⅝	11⅝	..	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	6 %	14⅜– 15	14⅜– 15	14⅜	14¹¹⁄₁₆	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½%	15 %	24 %	..	37½– 39½	38 – 40	..	..	+1
42,800	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99¼–101½	99¼–101½	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	5 %	57 – 59	57 – 59	58½	58	..
251,127	Marconi's Wireless Telegraph	1	..	..	..	..	1⅛– 1⅜	1 – 1⅛	27/6	..	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	4 %	..	⅞– 1	⅞– 1	19/9	19/6	..
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	..	⅞– 1	⅞– 1	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	114 –115	110 –111 xd	114½	110	..
1,966,667	Do. do. Def. Stock	100	4½%	5 %	5 %	5 %	111 –112	112 –114 xd	113½	108½	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12½ – 14½	12 – 14 xd	13¼	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	11 – 13	10½ – 12½xd	..	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5½ – 5⅝	5⅜ – 6⅜xd	5¹⁷⁄₃₂	5⅛	..
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	99 –101	99 –101	100	..	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	103 –105	103 –105	104¼	103½	..
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6¾%	6¾%	6 %	1¼– 1⅜	1¼– 1⅜	26/3	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	6 %	1¼– 1⅜	1¼– 1⅜	..	..	..
100,000	Do. do. do. 4% Red. Deb. Stock	100	..	..	..	4 %	97 – 99	97 – 99	97½	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	4 %	99 –102	99 –102	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	5 ⅜%	7¼– 7¾	7¼– 7¾	7¼	..	..
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	..	4½%	103 –106	103 –106	..	..	..
3,201	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	127 –130	128 –131	129½	..	+1
70,000	United River Plate Telephone	5	7 %	8 %	8 %	..	7¼– 7⅝	7¼– 7⅝	7⅝	7¼	..
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	5¾– 5¾	5¾– 5¾	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	5 %	110 –112	110 –112	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4³⁄₁₆%	4 %	9¼– 10	9¼– 10	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	⅜– ⅝	⅜– ⅝	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	100 –102	100 –102	100¼	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	5 %	14½– 15	14½– 15	14⅝	14⅜	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	5 %	100 –102	100 –102	..	..	..
563,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	102 –104	102 –104	103½	102½	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅜– ⅝	⅜– ⅝	..	..	..
84,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	6 %	8½– 8¾	8¼– 8¾	8⅜	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	6¾– 7⅛	6¾– 7⅛	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	100 –103	100 –103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

170,000	Anglo-Argentine Trams, 260,008 to 430,007	5	..	..	8 %	6 ⅝%	8½– 9¹⁄₁₆	8⅞– 9¼	9³⁄₁₆	8⅞	+⅛
260,007	Do. 5½ % Cum. Prefs., 1 to 260,007 ..	5	..	5 %	5 %	5½%	5⅞– 6⅛	5⅞– 6⅛	6³⁄₃₂	6	..
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	..	6 %	6 %	6 %	141 –144	141 –144	..	..	..
285,100	Auckland E. Trams., 5 % 1st Mort. Deb. Stock ..	100	..	5 %	5 %	5 %	104 –106	104 –106	105	..	..
800,000	Babcock & Wilcox, 1 to 530,000	1	..	17 %	20 %	16 %‖	3⅞– 4¼	4 – 4¼	82/6	81/10½	+ ⅛
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	..	6 %	6 %	6 %	1⅞– 1⅞	1⅞– 1⅞	..	..	..
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	..	..	..	2 – 2¼	2 – 2¼	..	..	..
40,000	Do. do. 7 % Cum. Pref...	5	Nil	Nil	Nil	3/6	5⅜– 6¼	5⅜– 6¼	6⅛	5⅞	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	3/-	5 – 6⅜	5 – 5⅝	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅜– 3½	2⅜– 3½	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	98 –102	98 –102	..	..	..
300,000	British Columbia E. Rail Def. Ord. Stock	100	..	6 %	6 %	..	120 –123	120 –123	..	..	..
300,000	Do. 5 % Pref. Ord. Stock	100	..	5 %	5 %	..	110 –113	110 –113	..	..	..
115,000	Do. 5 % Cum. Perp. Pref. Stock	100	..	5 %	5 %	5 %	108 –111	108 –111	..	..	..
240,400	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	..	4½%	4½%	4½%	103 –105 %	103 –105%	..	..	..
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	..	4½%	4½%	4½%	102 –105	102 –105	105	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	6 – 7	7 – 7⅛	7⅝	6½	+ ⅜
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 ⅝%	9¼– 10¼	9¼– 10½	10	9⅜	..
1,415,422£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	117 –120	117 –120	119½	118	..
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½%	4½%	98 –100	98 –100	98¼	97½	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	8 %	6⅜– 7¼	6⅜– 7¼	7	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5¾– 6¼	5¾– 6¼	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½%	4½%	4½%	4½%	103 –106	103 –106	..	..	..
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	..	4½%	4½%	4½%	98 –100	96 – 98 xd	..	..	..
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	..	6 %	Nil	..	1⅞– 2⅛	1⅞– 2⅛	..	..	..
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	..	4 %	4 %	4 %	80 – 85	80 – 85	81	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	⅝– ¹¹⁄₁₆	⅝– ¹¹⁄₁₆	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	⅜– ½	¾– 1	17/6	16/3	+ ⅛
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1½ – 2	1½ – 2	36/3	..	..
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	97 – 99	97 – 99	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	82 – 84	82 – 84	..	..	..
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	..	3 %	4 %	..	3½– 3⅝	3½– 3⅝	73/9	..	..
40,000	Do. "A" 6 % Cum. Pref., 1 to 40,000	5	..	6 %	6 %	..	5¾– 6¼	5¾– 6¼	..	..	..
27,500	Do. "B" do. 1 to 27,500	5	..	6 %	6 %	..	5¼– 5⅝	5¼– 5⅝	..	..	..
317,700	Do. 5 % Deb. Stock	100	..	5 %	5 %	5 %	106 –108	106 –108	106½	..	..
190,000	Do. 5 % 2nd Deb. Stock	100	..	5 %	5 %	5 %	102 –105	102 –105	104¼	104	..
105,000	Calcutta Trams., 1 to 105,000	5	..	6 %	8 %	7 ⅜%	9⅜– 10¼	9⅜– 10¼	9¹⁵⁄₁₆	9⅜	..
32,610	Do. 105,001 to 137,610	5	..	..	..	3d.	9 – 9¼	9 – 9¼	..	..	..
350,000	Do. 4½ % 1st Deb. Stock	100	..	4½%	4 %	4½%	106 –108	106 –108	106¾	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½%	12½%	10%	11 – 12	11 – 12	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅜– 6	5⅜– 6	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108⅜–110¾	108⅜–110¾	..	..	..
491,222	Cape E. Trams., 1 to 491,222	1	..	15 %	10 %	5 ⅜%	⅜– ½	⅜– ½	..	..	..
450,000	Castner-Kellner Alkali, 1 to 450,000	1	..	4 %	4 %	..	1⅛– 1¹⁄₁₆	1⅛– 1¹⁄₁₆	..	..	..
230,211	Do. do. 4½ % 1st Mort. Deb. Stock	100	..	4½%	4½%	4½%	95 –100	95 –100	98	..	..
1,939,698	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	91 – 93	91 – 93	93	91½	..
530,316	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	4 %	103 –105	103 –105	104⅜	104	..
530,316	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	81 – 84	81 – 84	83⅜	83	..
1,480,000	City and South London Railway	Stock	3½%	2⅞%	2½%	1⅞%	41 – 43	41 – 43	41½	41¼	..
85,000	Crompton & Co., Nos. 1 to 85,000	8	5 %	2½%	2½%	..	2 – 2¼	2 – 2¼	..	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	95 – 98 %	95 – 98	..	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
‖ And bonus of 10s. ¶ From Manchester Share List.

(Continued on next page.)

SHARE LIST OF ELECTRICAL COMPANIES.—*(Continued).*

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—*(continued).*

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	1905.	Closing Quotations Mar. 7th.	Closing Quotations Mar. 14th.	Business done week ended Mar. 14th, 1906. Highest	Lowest.	Rise + or Fall−
52,000	Dick, Kerr & Co., 1 to 52,000	† 5	..	..	10 %	..	8¾— 9¼	8¾— 9¼	..	..	..
61,000	Do. do. 6 % Cum. Pref., 1 to 61,000	5	..	6 %	6 %	6 %	6 — 6⅛	6 — 6⅛	6½	6⅛	..
294,150	Do. do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	104 —106	104 —106	..	..	..
60,000	Dublin United Trams. (1896), 1 to 60,000	10	..	5½%	6 %	6 %	13¾— 14¾	13¾— 14¾	..	..	..
59,987	Do. 6 % Pref. between 1 and 60,000	10	..	6 %	6 %	6 %	14½— 15½	14½— 15½	..	..	..
63,400	Do. 4 % Debs.	100	..	4 %	4 %	4 %	99½—100½	99¼—100¼	..	..	..
300,000	Do. 3½ % "A" Debs.	100	..	3½%	3½%	3½%	100 —100¼	100 —100¼	..	..	..
300,000	Do. 3½ % "B" Deb. Stock	100	..	3½%	3½%	3½%	97 — 97½	97 — 97½	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £8 pd., 1 to 99,261	5	Nil	Nil	2½%§	..	1⅛— 1⅛	1⅛— 1⅛	36/10½	..	..
17,139	Do. "A" shares, 01—017,139	5	Nil	Nil	2½%§	..	2½— 3	2½— 3	..	..	..
344,023‡	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	86 — 88	86 — 88	..	..	..
100,000‡	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	92 — 97	92 — 97	..	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	½— ¾	½— ¾	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	2 — 2½	2 — 2½	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Stk.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9¼— 9⅝	9⅛— 9⅝	9⅝	9³¹/₃₂	+ ⅛
200,000	Do. do. 4 % Mort. Deb.	Stock	4 %	4 %	4 %	4 %	95 — 99	95 — 99	95½	..	..
78,000	Gt. N. & City Rail Pref. Ord. "A" 4 % 1 to 78,000	10	..	3	4	4 %	4½— 5	4½— 5	..	..	..
96,000	Greenwood & Batley 7 % Cum. Pref.	10	..	7 %	7 %	7 %	10½— 11½	10½— 11½	..	..	..
80,000	Do. do. 5 % Mort. Debs.	100	..	5 %	5 %	5 %	102 —104	102 —103	..	..	— ½
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	20 %	15 %	15 %	15%	13 — 14	12¾— 13½ xd	13¼	12⅜	..
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5¼— 5½	5¼— 5⅝	5¼	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	.. — ..	.. — ..	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works.	10	10 %	10 %	5 %	10%	18 — 19	17⅞— 18⅝	18⅛	17¾	— ⅛
800,000‡	Do. do. 4% 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	99 —102	99 —102	..	..	..
37,500	‡Liverpool Overhead Railway, Ord.	10	1¾%	1¾%	1¾%	Nil	1⅜— 1⅝	1⅜— 1⅝	..	..	..
10,000	† Do. do. Pref. £10 paid	10	5 %	5 %	5 %	5 %	6¾— 7	6¾— 7	..	..	..
600,070	London United Trams (1901), 1 to 50,007	10	..	8 %	6 %	3 %	8 — 9	9 — 9⅛	..	..	..
399,930	Do. do. 60,008 to 100,000 (£4 paid)	10	..	8 %	6 %	3 %	2¾— 3¼	3 — 4	..	..	+ ⅜
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	..	5 %	5 %	5 %	9 — 9¼	9 — 9¼	9⅜	9¼	..
1,331,000	Do. do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	92 — 95	93 — 96	96⅛	..	+1
314,016	Metropolitan Electric Trams, Defd.	1	Nil	Nil	Nil	..	7/32— 9/32	7/32— 9/32	..	..	..
500,000	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1 1/16— 1 1/8	1 1/16— 1 1/8	..	..	..
350,000	Do. 4½ % Deb. Stock Red.	100	..	..	4½%	4½%	104 —106	104 —106	..	..	..
20,000	Peebles (B.) & Co. 6 % Cum. Pref., 20,001 to 40,000	5	..	..	6 %	6 %	4¾— 5¼	5 — 5¼	..	..	+ ⅛
24,500	Potteries E. Trc., 20,001 to 40,000 & 50,001 to 54,500	10	..	5 %	5 %	..	8¾— 9	8¾— 9	9⅛	..	..
24,500	Do. 5 % Cum. Pref., 1 to 20,000 & 40,001 to 44,500	10	..	5 %	5 %	5 %	9¼— 9⅜	9¼— 9⅜	..	..	..
245,000	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	103 —106	103 — 106	..	..	..
37,350	Telegraph Construction and Maintenance	12	20 %	20 %	15 %	15 %	34 — 36	32½— 34½ xd	..	..	..
150,000‡	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	4 %	100 —102	100 —102	..	..	..
3,599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	..	5 %	5 %	98 —100	98 — 100	..	..	..
540,000	Waterloo & City Railway, Ord. Stock	100	3¾%	3¾%	3¾%	3¾%	101 —104	101 — 104	..	..	..
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	8⅓%	6 %§	..	..	2¼— 2⅜	2¼— 2⅜	..	..	..
66,666	Do. 6 % C. P., 30,001 to 80,000 & 125,001 to 141,666	5	..	6 %	..	..	4 — 4⅜	4 — 4⅜	85/-	80/-	..
246,806	Do. 4 % 1st Mort. Deb. Stock	100	..	4 %	4 %	4 %	82 — 87	82 — 87	83	..	..

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P., 1 to 14,000	5	..	5 %	5½%	4 %§	5½— 5⅝	5½— 5⅝	..	..	..
50,000	Do. do. 4½ % 1st. deb. stock	100	..	4½%	4½%	4½%	103 —106	103 —106	..	..	..
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	8 %	10 %	10 %	10 %	8¾— 9¼	8¼— 9¼ xd	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	8¾— 9¼	8¼— 9¼ xd	..	..	..
300,000	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	102 —105	102 —105	104½	..	..
80,000	Charing Cross and Strand Electricity Supply	5	10 %	8 %	8 %	5 %	4⅜— 5⅛	4⅜— 5⅛	5⅛	98/9	+ ⅛
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	4⅝— 5⅛	4⅝— 5⅛	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	4¼— 4⅜	4¼— 4⅜	..	..	..
40,000	Do. do. 1903	5	..	4½%	4½%	4½%	4¼— 4⅜	4¼— 4⅜	..	..	..
420,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	101 —103	101 —103	..	..	..
44,296	Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	6 %	5¼— 5⅜	5¼— 5⅜ xd	5¼	..	..
175,000‡	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	108 —110	108 —110	..	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	6 %	10⅜— 11⅜	10⅜— 11⅜	11¼	11⅛	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	13½— 14½	13½— 14½	..	..	..
400,000‡	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	123 —126	123 —126	124½	123½	..
800,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	100 —102	101 —103	..	..	+1
40,000	County of Durham Electrical Power, Ord.	2	4 %	4 %	£3 7 0	4 %	1⅞— 2⅛	1⅞— 2⅛	..	..	..
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	5 — 5⅛	5 — 5⅛	5⅛	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	5 %	8½— 9¼	8½— 9¼	8 31/32	..	..
80,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	12⅜— 12⅝	12⅜— 12⅝	..	..	— ⅛
400,000‡	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	109 —112	109 —112	111⅜	110¼	..
400,000	Do. do. 4½ % 2nd Deb. Stock	Stock	4½%	4½%	4½%	4½%	101 —103	101 —103	102⅛	102	..
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	7 %	5 %§	4¼— 4⅜	4¼— 4⅜	87/8	86/3	..
80,000	Do. do. 6 % Cum. Pref.	..	6 %	6 %	6 %	6 %	5½— 5⅝	5½— 5⅝	5⅝	..	..
320,000	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..
10,000	Folkestone, 1 to 10,000	5	..	5½%	5½%	4 %§	5¼— 5⅜	5¼— 5⅜	..	..	..
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	..	5 %	5 — 5⅛	5 — 5⅛	..	..	..
75,000	Do. 4½ % 1st. Deb. Stock	100	..	4½%	4½%	4½%	101 —104	101 —104	..	..	..
13,000	Hove, 1 to 13,000	5	..	8½%	8½%	9 %	8¼— 9	8¼— 8⅞	..	..	— ⅛
10,000	Do. New (£5 10s. paid)	£3	..	8½%	8½%	9 %	8¼— 8⅜	8 — 8¼	..	..	— ⅛
37,300	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	94 — 97	97 — 99	..	..	+2½
7,300	Do. 4½ % Deb. Stock	100	..	4½%	4½%	4½%	96 — 99	97 — 99	..	..	+ ½
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	12½	12 %	10 %	9¼— 10¼	9¼— 10¼	..	..	..
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	4 %	2⅜— 2⅞	2¼— 2⅜ xd	..	..	..
60,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	5⅜— 5⅝	5¼— 5⅜ xd	5⅜	5⅛	..
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	98 —101	98 —101	99⅛	..	..
200,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10 %	8¼— 9¼	8¼— 9¼	9⅛	8⅞	..
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	4½%	5⅜— 5⅝	5⅜— 5⅝	5 15/16	..	..
220,000‡	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	110 —114	110 —114	..	..	..
250,000‡	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	95 — 97	95 — 97	95¼	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	101 —103 %	101 —103	..	..	..
57,009	Newcastle-on-Tyne, 1 to 57,009	5	..	8 %	8 %	8 %	8 — 8¼	8 — 8¼	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	8 %	8 — 8¼	8 — 8¼	..	..	..
57,009	Do. 5 % Pref., 1 to 57,009	5	..	5%	5	5 %	6¼— 6⅝	6¼— 6⅝	..	..	..
17,991	Do. 57,010 to 75,000	5	..	..	..	5 %	6¼— 6⅝	6¼— 6⅝	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	7½%	13⅜— 14⅜	13 — 14 xd	..	..	..
64,000	Do. do. 4 % 1st Mort. Deb.	100	4 %	4 %	4 %	4 %	98 —100	98 —100	..	..	..
18,500	Oxford, 1 to 96 and 407 to 18,810	5	..	6½%	7 %	7 %	6½— 7	6¼— 6⅞ xd	6⅞	..	..
50,000	Do. 4 % Deb. Stock	100	..	4 %	4 %	4 %	99 —101	98 —100	..	..	—1
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	12½%	9 — 10	9¼— 10¼	9 15/16	9¼	+ ⅛
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	7⅞	..	..
150,000‡	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3½%	3½%	97 — 99	96 — 98	..	..	—1
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	4 %	2¼— 2⅜	2¼— 2⅜	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	76 — 80	76 — 80	..	..	..
65,000	South London Electricity Supply, Ord.	5	12½%	3 %	4 %	4 %	3¼— 3⅜	3¼— 3⅜	72/6	..	..
103,700	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	2½%	⅞— 1	⅞— 1 xd	..	..	..
85,368	*(Late Blackheath and Greenwich* 7 % Pref.	1	Nil	7 %	7 %	7 %	1¼— 1⅜	1¼— 1⅜ xd	..	..	..
148,292	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	105 —108	105 —108	..	..	..
50,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	4¼— 4⅜	4¼— 4⅜	91/3	..	..
30,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	5⅛	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	4½%	104 —106	104 —106	105⅜	105	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	13 %	10 — 11	9¾— 10¼ xd	9⅞	..	..
28,151	Do do. 4½ % Cum. Pref.	5	5 %	5 %	5 %	5 %	5 1/16— 5 3/16	5 1/16— 5 3/16	5 3/16	5⅛	..

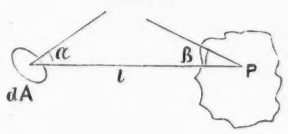
Shares not officially quoted :—Mackay Companies, ord., 61—63. Pref. 76—78.
† Unless otherwise stated all shares are fully paid. § Interim dividends.

Bank rate of discount 4 per cent. (September 28th. 1905).

THE GLOBE PHOTOMETER.

We have recently received from Dr. L. Bloch a reprint of an article from the *Elektrotechnische Zeitschrift* (1905, Nos. 46, 47), giving an account of the theory of, and experiments with, the Globe photometer; and Dr. Bloch sends us in MS. a revised account of the mathematical theory of the instrument. The principle of the method was described by Prof. Ulbricht (*Elektrotechnische Zeitschrift*, 1900, No. 22), but is not, we believe, generally known, or in common use, so that some account of it will be of interest to electrical engineers. The function of the apparatus is to give by one observation

Fig. 1.



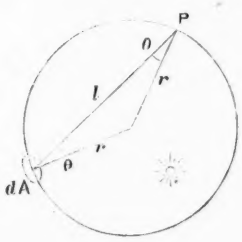


Fig. 2.

the value of the whole amount of light emitted by any source, such as an arc lamp or an incandescent lamp. It has no relation to the light distribution in different directions, to which other ordinary methods of measurement are applicable. The general theory is as follows: When a source of light is placed inside a spherical shell having a matt surface, the light received by any part of the interior surface can be divided into two parts—(*a*) the light received directly from the lamp, and (*b*) the light received from the remainder of the interior surface of the sphere, after one or more reflections. The quantity (*a*) is that which is measured in the usual photometers which determine the intensity of the light emitted in one direction, and is not considered at all in the Globe photometer. By the theory of the Globe photometer the quantity (*b*) is constant all over the surface of the shell, and is proportional to the total amount of light emitted by the lamp, quite independently of its position in the shell.

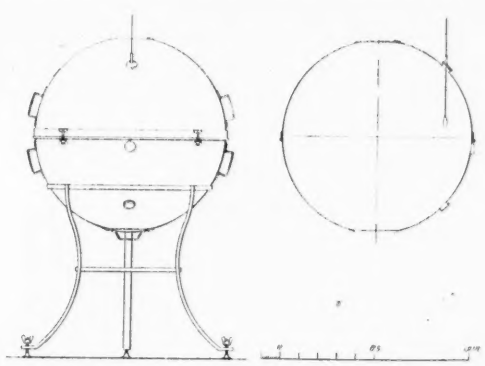


Fig. 3.

In other words, if a lamp be hung inside a spherical shell with a matt lining the illumination of any part of the shell which is screened from the direct light of the lamp is the same as of any other part, and measures the total amount of light measured by the lamp.

The argument is as follows: Suppose a surface P (fig. 1) to be illuminated by radiation from a small luminous area dA, whose brightness is B; then, by the ordinary formula, the light received by a unit surface at P is $B\,dA\cos\alpha\cos\beta/l^2$, α, β being the angles made with l by the normals to the two surfaces.

Next let fig. 2 represent the spherical shell of the photometer into which is inserted for measurement a lamp, roughly indicated in the figure, and consider the illumination of the surface at the point P by light reflected from a small area dA. The circle drawn is that central section of the shell which passes through dA and P. Let the light received directly from the lamp on to the small area dA be $L_A\,.\,dA$; so that $\int L_A\,.\,dA$ (integrated over the sphere) $= E$, the total light emitted by the lamp. Then the brightness of dA, which being perfectly matt throws light equally in all directions, is $k\,L_A$, k being a constant for the particular matt surface used; and (using the expression of the last paragraph) the light received from dA on a unit of surface at P is $k\,L_A\,.\,dA\cos^2\theta/l^2$ which $= k\,.\,L_A\,dA/4\,r^2$. This last expression gives the illumination at P by light which has been once reflected from the lamp by the surface dA. Hence the illumination at P by once reflected light from the whole surface of the sphere $= k/4\,r^2\int L_A\,.\,dA = k/4\,r^2\,.\,E$. . It follows at once that the illumination at P by twice reflected light $= (k/4\,r^2)^2\,.\,E$. So that the total illumination at E by reflected light $= E\,\{k/4\,r^2 + (k/4\,r^2)^2 + (k/4\,r^2)^3 + \ldots\} = K\,E$, where K is a quantity depending only on the dimensions of the sphere, and the quality of its internal surface. It is, in fact, a constant of the instrument. The illumination then by reflected light is uniform all over

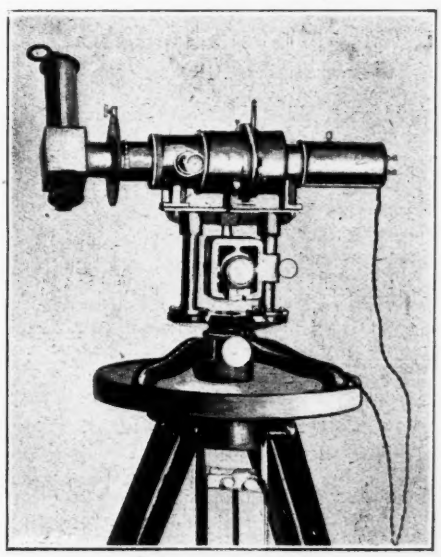


Fig. 4.

the surface of the shell, and is proportional to E; so that, screening off the direct light from the lamp from any small area, the remaining illumination of that area is a measure of the total light emitted by the lamp.

The strict application of the above argument requires a perfectly matt surface, and that the fittings or mechanism of the lamp shall not interfere with the repeated reflections by the surface of its own light; neither of which conditions can be entirely met in practice. The first condition is met approximately by coating the surface with lithopone (barium sulphate), and the second by making the shell large compared with the lamp; and experiments show that the errors do not prevent useful results being obtained.

The apparatus consists of two parts, the spherical shell or globe, and the measuring instrument or photometer.

The globe (fig. 3) is constructed of two hemispheres 1 metre in diameter pressed out of sheet zinc, 2 mm. thick. The hemispheres are bolted together by screws to a steel ring, so that the shell can be opened when required, and the whole is mounted upon a tripod stand of a convenient height for observation. Large holes are made in the top and bottom for the insertion of the lamps, and three small holes, 50 mm. diameter, on a vertical meridian to be used as observation holes. The whole of the inside is covered with a white paint

(barium sulphate) which has an approximately perfect matt surface. A perfect matt surface is one which reflects light equally in all directions independently of the direction of the incident light, and the coating of barium sulphate satisfies this condition sufficiently for practical purposes. In using the apparatus the lamp is introduced into it through one of the large holes, and the photometer is brought to one of the observation holes. The small screen used to shield the photometer from the direct light from the lamp is seen in position in the sectional view. In some cases, *e.g.*, ordinary incandescent lamps, the source of light is lowered completely into the globe; but in the case of an arc lamp, in which the mechanism is bulky and would interfere considerably with the reflected light, the arc may be placed at or near the surface of the globe, the greater part of the mechanism being then outside. When the lamp is placed completely inside the globe the mean spherical intensity is obtained by dividing the result of the measurement by 4π; but when it is at the surface only that part of the total light is measured which is emitted below the horizontal plane, and dividing the result by 2π gives what Dr. Bloch terms the mean hemispherical intensity for the lower hemisphere.

The photometer used by Dr. Bloch was designed on the principle of Dr. Brodhun, and was manufactured by the firm of Messrs. Franz Schmidt & Haensch, of Berlin. It is shown in perspective in fig. 4, and in section in fig. 5. A small plate of plaster of paris, S (fig. 5), having a matt

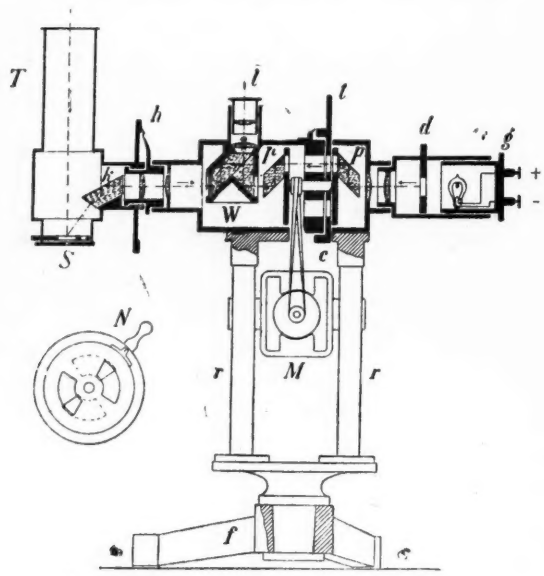


Fig. 5.

surface, is illuminated from the source under measurement by light passing along the tube T. Light emitted from S is reflected through the prism k, the lens system below h, and the prism W into the eyepiece l. On the other side light from an opal glass screen d, illuminated by a small incandescent lamp g, passes through a lens system, through the prism system $p\ p$ and the prism W up into the eyepiece L. The prism W is made in two parts, which touch one another all over the surface shown in the figure by the oblique line of division. They are cemented together over a small central elliptical area, so as to be in optical contact there, but not elsewhere. Light falling on the surface from the left—*i.e.*, coming from S—is reflected upwards into the eyepiece, except from the cemented area, through which it passes freely and is lost. Light falling on this surface from the right—*i.e.*, coming from d—passes freely upwards through the cemented area into the eyepiece, and is reflected back from the rest of the surface. Consequently, the field viewed through the eyepiece consists of a central circular area illuminated from d, and a ring enclosing it illuminated from S. The manipulation of the instrument consists in adjusting the handle t, and so regulating the light from d, until the central circular area seen under the eyepiece appears to be equally luminous with the surrounding ring. It remains to explain the construction of the prism $p\ p$ and the regulator t. The two prisms $p\ p$ are mounted upon an axle driven by a small electric motor M, and supposing no screens or diaphragms are interposed, the light from d will fall continuously upon W after four reflections through the two prisms, notwithstanding the rapid rotation of the system. The pair of diaphragms t, shown in plan at N, are designed to interrupt the light during each revolution to an extent that can be adjusted and

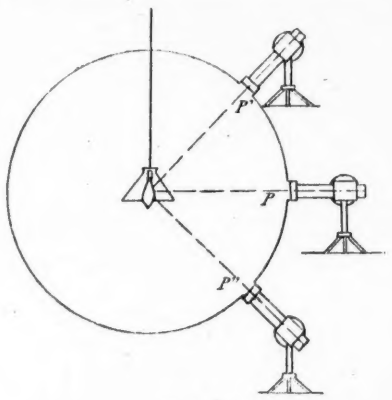


Fig. 6.

indicated from outside by a scale attached to the handle t. The form of the diaphragms, of which one is fixed and one movable, is shown at N, and each has a pair of sector-shaped apertures which may be made more or less completely to correspond with one another. By Talbot's law, the illuminating effect of a rapidly intermittent light is proportional to the time it is seen, and is independent of the mode of intermission, provided that the intermissions are sufficiently rapid not to be perceptible. By moving t, the light passing from d to W, and the consequent brightness of the central area seen in the eyepiece, can be regulated in a proportion read exactly by the scale of t, and independent of the speed of the motor. Thus this photometer compares two sources of light, not as is usual with other photometers, by adjusting their relative distances from the observing apparatus, but by rapidly interrupting one of them in a determined way until they appear equally bright in the observation eyepiece.

It will be noticed that the tube T (fig. 5) is constructed to turn about the general axis of the instrument, and that its position can be noted by the attached scale and pointer h. This enables the observer to compare any given light with a standard light, *e.g.*, a Hefner lamp, by directing the tube first to one and then to the other, and adjusting the interrupter t in each case to obtain a uniformly lighted

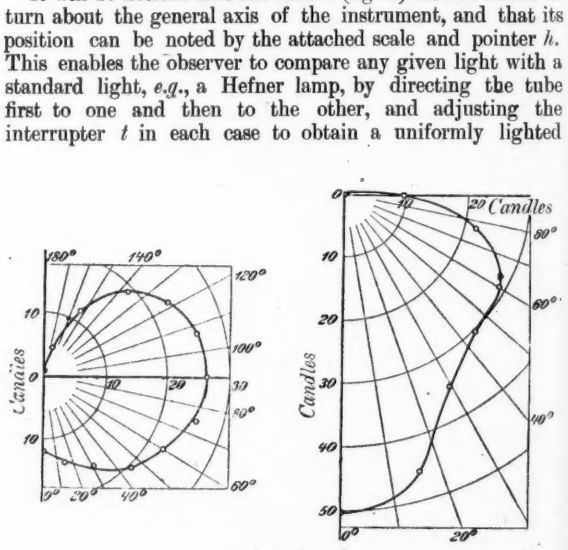


Fig. 7.

field under the eyepiece. Then the two readings of t give the ratio between the two lights.

The last point to consider is the determination of the constant of the globe itself, which is done by placing in it, and observing, a standard or a previously standardised lamp, when the reading of the Brodhun photometer at one of the observation holes is compared with the reading of a Hefner lamp placed at a measured distance.

In conclusion, we extract from Dr. Bloch's paper the figures of a set of tests made on an incandescent lamp to determine how closely the observed values corresponded with the theory of the instrument. The lamp was hung near the centre of the globe, and observations were made from the three observation holes p', p, p''. Fig. 6 shows the general arrangement with the photometer in position at each hole. Measurements were taken with and without a shade over the lamp, and with and without screens between the photometer and the light. Fig. 7 shows the distribution of the light from the lamp with and without the shade, the diagram on the right representing the case with a shade, that on the left without. The figures obtained were as follows :—

Conditions of the experiment.	p'.	p.	p''.
Lamp unshaded, observation hole not screened	56	54	58
" " " " screened	41	40	41
" shaded " " not screened	28	27·5	48
" " " " screened	28	27	27·5

It is seen that in both cases when the direct light of the lamp is screened off, and only the illumination by light reflected from the walls observed, the result is closely the same for all the three windows. The result with the shaded lamp, whose light distribution is very irregular, is the more instructive.

Dr. Bloch's paper gives some details of construction beyond what we have abstracted, as well the results of a large number of observations made with the same lamp placed first near the middle of the globe, and afterwards at the surface, giving in one case the mean spherical intensity, and in the other the mean hemispherical intensity. For these, and for a much longer mathematical treatment than appears to be necessary, we refer our readers to the original papers in the *Electrotechnische Zeitschrift*.

PROCEEDINGS OF INSTITUTIONS.

Waste in Incandescent Electric Lighting.

By Geo. Wilkinson, Member.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Leeds, February 15th*, 1906.)

The supply of electricity for lighting purposes is, and must remain, the backbone of business, so far as most electric generating works are concerned.

During the last few years many improvements have been made in arc lamps, and their use is likely to extend largely. Nevertheless, the major portion of electric lighting is, and will continue to be, carried out by means of incandescent electric lamps.

The average prices obtained per unit in Great Britain (omitting exclusively tramway undertakings) during 1904 and 1905 were as follows:—

Year ending	March, 1904.	March, 1905.
Limited liability undertakings ...	4·26d.	4·06d.
Municipal undertakings	3·08d.	3·02d.

It is beyond the meter fixed on consumers' premises, which marks the boundary of the supply undertakers' authority and jurisdiction, that waste and extravagance take place.

So marked is this lamentable waste, and its effect upon the future of electric lighting is so serious, that it is high time some definitely concerted action was taken by the supply authorities throughout the country to deal effectively with the matter, and to educate every consumer so that he may know how to get efficient electric lighting at a reasonable cost.

Gas companies have not been slow in taking advantage of our carelessness in this matter; they recognise that their customers want a good light on a minimum consumption of gas. This they ensured for them by installing in their showrooms the most efficient gas lighting appliances, and by taking steps to make such appliances known to gas consumers; also they take good care to imitate electric lighting as closely as possible in their design and arrangements of fittings. The effect of this enterprising policy is to be seen in most towns, especially in the business quarters, where numbers of shops which a short time ago were illuminated exclusively by electric glow lamps are now mainly lit by the incandescent gas mantle; the front window show-cases being alone reserved to the electric lamp. Thus the long-hour lamps go to the gas company's credit, and the short-hour unprofitable lighting to the electrical undertakers. A similar undesirable process is going on in private residences.

To show the urgent need for attention on the part of engineers to the points raised, I set forth a few of the many cases which have come under my personal notice during the last few months.

(*a*) *Public Building.*—Eighty 32-c.p. British-made 100-volt lamps, taking an average of 170 watts each. The light in this case was exceedingly unsatisfactory, owing to drop in pressure, and, by putting in 16-c.p. lamps certified by the Corporation (as hereinafter explained), the light was improved and the current consumption very greatly reduced.

(*b*) *Private House.*—Consumer using 8-c.p. British-made lamps giving, in one case, only 2·1 c.p. at 11 watts per candle, and another 3·2 c.p. at 8 watts per candle; also one 16-c.p. giving 8·9 c.p. at 6·6 watts per candle.

(*c*) Four special 16-c.p. 200-volt foreign lamps, sent for test, dropped from 16 c.p. to 7 in less than 100 hours. These might have been used on consumers' premises with disastrous results.

(*d*) *Private House.*—Consumer found to be using 230-volt lamps on a 200-volt circuit.

Investigations in one of the chief cities in Lancashire on new 16-c.p. lamps held in stock by the Corporation, showed a variation of from 3·25 to 8 watts per candle, with a variation in c.p. on standard voltage from 10¼ to 20 candles.

I am convinced that in many towns the cost of electric lighting is greatly increased to the consumer, due to errors in the grading and marking of lamps. So far as I can ascertain it appears to be the general practice amongst lamp-makers to sell lamps marked with a nominal c.p. but actually giving considerably less than that marked on the bulbs.

Clause No. 18 of the 1882 Electric Lighting Act should be immediately abolished, and a new clause substituted, giving the electricity supply undertakers the right of supervision over the lamps used on their supply mains, and the right to refuse to supply customers using wasteful lamps. In my view this desirable supervision can be exercised without the undertakers taking the lamp trade from the local contractors: such a step on the part of municipalities would be an unwarrantable and unfair interference with the business of private tradesmen in the district.

I have, in co-operation with the local contractors in Harrogate, developed a system of control over the lamps used, which leaves the contractors the benefit of their trade in lamps, and puts no restriction upon them as to what make or class of lamp they supply to their customers.

Twelve months ago I drew out a specification (see appendix), which was issued to all lamp manufacturers supplying lamps to the district, with the intimation that in future lamps would not be certified for use on the Harrogate supply mains which did not come within the specification, both as to candle-power and wattage. Considerable feeling was manifested on the part of several manufacturers, due to the constant refusal of lamps; now, however, very few lamps fail to pass the required tests, and the consumer has already begun to feel the benefit of their improved efficiency. We have numbers of instances where the accounts have decreased since certified lamps were used, and the ultimate result is bound to be an increase of business accruing to the electricity department.

A notice is attached to the quarterly account calling the attention of the consumer to the importance of using, exclusively, lamps certified by the supply authority, and warning him against buying lamps from casual travellers (see Appendix).

The question of the efficiency and grading of lamps has recently been taken up by the Municipal Electrical Association, and a more comprehensive and detailed specification than that set forth in the appendix has been drawn up; but its issue to the members of the Association is postponed at the request of the Physical Standards Sub-Committee of the Engineering Standards Committee, and the Municipal Electrical Association has elected Mr. C. D. Taite and myself as its representatives on this Sub-committee. Doubtless the effect of the Municipal Electrical Association's recommendations, when issued, will be beneficial to all parties concerned, and especially to the consumers.

In ordering lamps from manufacturers, the specification generally fixes a maximum of 20 per cent. drop in candle-power on a 400 or 600 hours' run. In making this test a maximum rise in pressure of 2 per cent. should be allowed, as closer regulation is not obtained on public supply mains. A difficulty presents itself in the length of time required to verify the drop in candle-power; very few makers or dealers will consent, or can afford to lay large stocks of lamps aside for five or six weeks while drop in candle-power and life tests are being made on sample lamps drawn from each consignment; the consequence is that these important tests are almost entirely neglected, and, in the writer's opinion, large numbers of lamps are continually put on circuit which blacken prematurely and bring discredit upon the industry. Experiments which I have made show that a very thin film of deposit on the internal surface of the glass bulb serves to reduce the light by 50 per cent., and a lamp loses two-thirds of its original candle-power before it gets to the condition commonly accepted as "black."

The lamp merchants should rigidly insist upon the makers submitting a percentage of each batch of lamps to an independent and recognised authority for drop in candle-power test, such lamps being selected promiscuously from the bulk; and the maker should furnish a certificate setting forth the results of such tests.

A life test is not nearly so important as the drop in candle-power test, and lamps which show good results on candle-power after the specified number of hours may generally be accepted as satisfactory on the score of durability.

It is better to use lamps with large glass bulbs, as the internal blackening process is thus spread over a greater area, and is therefore thinner, presenting less obstruction to the light. This view is confirmed by the rapidly increasing use of lamps with large spherical

bulbs, which do not reveal the blackening process nearly as quickly as the ordinary sized glass bulbs.

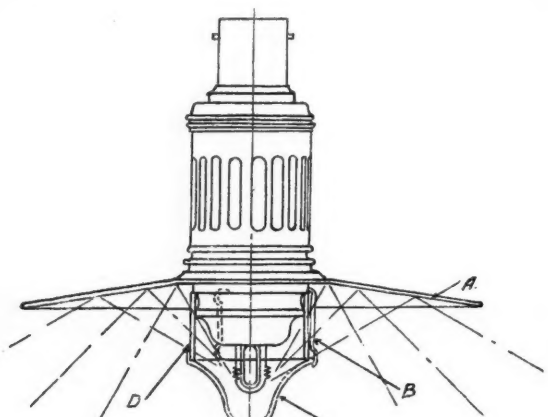
Fortunately the time of test can be shortened to about 150 hours by applying a slightly increased uniform pressure, but this method at present is followed by only one or two British firms; it is, however, common in America, and will doubtless become regulation practice everywhere in the near future.

The large number of lamps which are likely to be submitted for test in all local centres where lamp supervision and certification is adopted and the small charge which can be made per lamp (½d. in the case of Harrogate), necessitate expeditious methods, giving reliable results. The writer has experimented in many directions and with many instruments before arriving at a fairly expeditious, reliable and simple method, employing current derived from the ordinary supply mains.

Lamps which pass are stamped upon the glass bulb by means of a rubber stamp and etching fluid, with the word "Certified" and the initials or crest of the authority. The equipment is not expensive, and it is not too delicate for a youth of ordinary intelligence to use. The average rate of testing, including every operation, is about four dozen lamps per hour, and there appears to be no good reason why in regular work the rate should not be increased to six dozen per hour.

The present low average efficiency is, at least in some measure, the result of bad pressure regulation on the supply network, which is destructive to high efficiency lamps, causing premature blackening on the inner surface of the glass bulbs and shortening the useful life of the lamps.

An approximately uniform pressure should be continuously maintained by some type of automatic apparatus; the too common practice of trusting to hand regulation should be abandoned, as it is at best both spasmodic and unreliable. The direct current stations are the worst sinners in this respect. Doubtless, recently obtained motive power loads, which are supplied from the lighting



A, Opal reflector; B, Three-pronged clip; C, Opal cup "diffuser" carried by clips; D, Clear glass cylinder "draught excluder."

Fig. 1.—Nernst Lamp fitted with Wilkinson Diffuser and Reflector.

distribution mains, have in some instances rendered the already unsteady pressure much worse, and to sacrifice the steady pressure necessary for good lighting in order to pick up a few motors is questionable policy. Circuits for the supply of power should be separate from those supplying light, when the fluctuations due to varying and erratic power load will not have a prejudicial effect upon the lighting.

Regard should be paid to the fact that carbon filaments have a negative characteristic, *i.e.*, the higher the temperature the less their resistance, and until filaments having a positive characteristic come into general use, uniform electrical pressure for lighting must remain a factor of prime importance.

The experiences of engineers with the Nernst lamp are very conflicting. The Nernst lamp, notwithstanding the steadying effect of the wire compensator, is very sensitive to fluctuations of voltage.

The writer has found the burners last well on both direct and alternating current circuits, but in each instance automatic pressure regulators are used which keep the voltage variation within 2 per cent. In street lamps the average has been close on 500 hours per burner. For street lighting the B and D type of burner are of very little use, as they cannot be depended upon to light up on a cold or stormy night, due to the filaments being below the heaters; also the heaters are particularly frail and liable to break. The A type lamps, on the other hand, will light up within a minute on the coldest night, and the 100-watt A type filament, due to its superior conformation, gives approximately 30 per cent. more light on the roadway than the 100-watt D type burner, which has a U-shaped filament. A type lamps are, however, expensive, and the writer has adapted the A type burner to the D type body, whereby the cost is reduced to less than half that of the A type lamp, while the lighting efficiency of the A type lamp is obtained. This has been recognised by the Nernst lamp manufacturers, who are now arranging to put a lamp of this type on the market, which for convenience I have designated the AD type.

The AD type lamp, put into clear well-shaped glasses and supplied with current at 1d. per unit is in successful competition with the gas mantle for street lighting in several towns, and their use in this way will doubtless rapidly increase in the near future.

Nernst lamps—especially the B and D types—are badly designed from a light-giving point of view; the opaline globes—especially the pear-shaped pattern—obstruct a great amount of light, and there is no means of placing a reflector in an effective position.

Recognising this the writer designed and patented the modifications illustrated in fig. 1, and has obtained thereby a wonderfully improved lighting effect.

Below the angle of 20° from the horizontal, which includes all the useful lighting area, the mean spherical candle-power shows an efficiency of one candle per watt, a result unapproached by any other electric lamp of small candle-power.

Some good examples of vacuum-tube lighting can be seen operating in business premises along Broadway, New York, notably at the office of the *New York World*, which is illuminated by one tube 86 ft. long, running round the office and fixed beneath the ceiling cornice; lighting tubes of this class are in operation up to 155 ft. long. They are operated by extra high pressure alternating current, ranging from 5,000 volts upwards, produced by a transformer enclosed in an earthed metal box. The light produced is soft and agreeable, and is a near imitation of daylight. The intensity of light can be regulated from a faint glow to 20 or more candles per foot of tube, which tubes are about $1\frac{3}{4}$ in. in diameter. The illuminated tube can be looked at without inconvenience to the eye, and it appears as though it were a long cylinder of densely white smoke. The light radiating from such a large surface area gives a very perfect diffusion, and a practically "shadowless light" result. No mercury is used in these tubes, and the makers claim an efficiency as high as $1\frac{1}{2}$ watts per candle, including a transformer loss, and state that the life of the tubes is "almost unlimited."

Very little information is available about this form of lighting. I cannot find that there are any of these lamps in Great Britain, but the American examples are strikingly effective, and the method is worthy of more attention than it obtains at present. Probably the ultimate form of electric lighting will be by means of incandescent vapour, of which the well-known mercury vapour lamp forms an unsatisfactory and crude example.

Mr. R. L. Acland (communicated): I am fully in accord with Mr. Wilkinson's plea for greater attention to be paid to the subject of incandescent lamps by station engineers and others controlling the supply of electricity, and I have recently instituted a system somewhat on the lines of Mr. Wilkinson's arrangements for lamp testing. During the two months this has been in operation, some 2,000 lamps have been dealt with, among which have been found many samples quite as bad as those quoted by Mr. Wilkinson. We also sell lamps at a reasonable margin of profit. Mr. Wilkinson advocates working hand in hand with the contractors, in which I certainly agree with him, as they are indeed our most useful canvassers, but no mention is made of the price at which they shall sell these lamps. It is this charging from 1s. 3d. to 1s. 6d. per lamp, which is a premium on consumers continuing to burn lamps when they have long passed their useful life, with the result that there is discontent all round. It certainly seems that "free lamps," instead of discount, is the best solution of the difficulty, and is one which is very largely adopted in the United States, where the incandescent lamp question appears to be looked after very much more carefully. Does it not seem reasonable in certain outlying districts, where the pressure is low, to put in, say, 235-volt lamps when your declared pressure is 240?

Mr. S. E. Fedden (communicated): I am not convinced that lamp selling is the mainstay of an electrical contractor's business; it certainly is not in the case of the Sheffield Corporation, where the lamp sales amount to less than 7 per cent. of the business. All lamps purchased and sold by the Corporation are supplied to a specification, and tests are carried out on a certain number of lamps from each consignment. I agree that a closer regulation than 2 per cent. is not obtained on supply mains. Supply authorities in England often follow the practice of "applying a slightly increased uniform pressure"—unwillingly, of course. The author should bear in mind that automatic apparatus prevents fluctuation, but cannot level the pressure over all the network. It is not financially possible to use separate circuits for power and light, to say nothing of the increased complexity of the system which would be caused. My experience of Nernst lamps has not, up to the present, been satisfactory. The only burner which has lasted any length of time has been one fitted with the author's diffuser.

Mr. H. Boot (communicated): Mr. Wilkinson brings home in a very practical manner the fact that the major portion of the waste and extravagance takes place beyond the boundary of the supply authorities' meter. I find printing notices on the accounts, and sending out quarterly letters to the consumers, calling the attention to the serious waste taking place due to the continual use of lamps that are worn out, has very little effect, and I have for years advocated the necessity for the supply authority inspecting, changing, renewing and advising on consumers' lamps. I do not agree with the writer in his remarks with respect to contractors supplying lamps; it costs a consumer so much more to renew his lamps, because the wiring contractor is not satisfied with a small profit on the lamp. If the supply authority made a point of renewing consumers' lamps and maintaining them, the cost to the consumer of electric lighting, as a whole, would be greatly reduced. It would hit a certain number of contractors at first, but ultimately it would be largely for their benefit, because many more people would have their houses wired. It is becoming more difficult to keep the regulation of pressure within 2 per cent. every day, owing

to the intermittent demand for power, and I have had to draw up strict regulations with regard to the connection of motors to the mains, and the fluctuation to the pressure caused thereby. I have tried Nernst, Tantalum and Osmi lamps on my public lighting circuits, and so far the most successful have been the "Osmi" when burning four in series on 220 volts.

Mr. Taite (communicated): Seeing that incandescent lamps are all made to practically one pattern, it cannot be expected that a consumer should be on his guard against being supplied with inferior lamps. There is also the danger that, if he should ask for a high efficiency lamp, he might be supplied with a short life lamp, and probably he would rather pay more for current than be worried with frequent renewals. If all station engineers were to adopt the method which Mr. Wilkinson has found so successful, it would be a long step in the right direction. I, however, cannot go so far as the author of the paper, when he contends that the supply authority should have the power to compel consumers to use certified lamps. The automatic regulators to which the author has referred, are of great assistance. What is wanted now is a cheap and reliable regulator, applicable to self-excited direct-current generators. The regulator, however, cannot be expected to deal with a purely local disturbance on a large network. In such cases, if the station is a direct current one, additional copper is usually the only remedy. I think that when the recommendations of the I.M.E.A. in conjunction with the specification of the Standards Committee are issued, they will be found to be acceptable to lamp-makers and retailers alike, and they will be the means of substantially reducing the existing waste.

Mr. Campion said that the use of badly-graded lamps was one of the drawbacks to the present lighting system. Another fault was the astonishing amount of slackness in design and arrangement shown by the wiring contractors and architects. Personally, he had no idea there was such bad lamps as 6·6 watts per candle. In some cases he knew contractors were charging as much as 50 per cent. more than cost for the lamps, and the consumers could not stand it. He complained of the repairs charged by contractors, and intimated that if they were going to be so excessive, the authority would very seriously have to take up the idea of installation work. He did not think any town could afford to lay down separate mains for power consumers. He would like to know the limit in variation of pressure with 220-volt lamps, in order to retain a decent light. Lampmakers had not improved that at all.

Mr. Woodhouse remarked that improvements in the station were not so necessary as in consumers' installations. They were selling light not current. The fact that the companies obtained a greater average price than the local authorities was not due to inherent wickedness on the companies' part, but to local conditions. He agreed that the wiring contractor was a valuable canvasser, and should be encouraged. Mr. Wilkinson's system of ensuring good lamps to the consumers was excellent; there were other ways of doing this. One system which worked successfully was to change all the consumers' lamps every six months, and supply new ones. Those taken out were tested for wattage and candle-power; those that did not come within certain limits were destroyed, and the others were returned to stock ready to be sent out again. The cost of doing this could be included in the price per unit charged for energy.

Mr. A. S. Blackman said that Mr. A. H. Gibbings had initiated a system of supplying free lamps in Bradford, and after two years' experience in working the system, he thought it was one of the very best things that had been done in the way of looking after the consumers' end of the problem. They had been distributing something like 14,000 lamps per annum, and the cost of supplying them amounted to less than 3 per cent. of the consumers' bill. This could be looked upon as a discount of 3 per cent., and it was rather interesting to note that previous to the free lamp scheme the consumer had a discount of 2½ per cent. allowed for prompt payment, but the free lamp system was found to ensure this very much better than the giving of discount. In his opinion it was very much preferable to registration at the cost of ½d. per lamp, as suggested in the paper. On the new switchboard at Bradford, each of the low tension feeders was provided with a recording log, which gave a continuous record of the amperes passing through the feeder and the volts at the feeding point, and in that way an automatic load curve for each feeding area was obtained daily. Since the districts had been split up, the results were much better, but not so good as they expected to get in the near future, when some 10 extra L.T. feeders would be put into commission. It would be too serious to curtail the motor load for regulation purposes. He preferred a good switchboard attendant to any automatic device. The records were put up in the engine room, and everything was done to encourage very keen competition between the men having the supervision of the switchboard attendants. They had recently got into trouble by supplying consumers with certain foreign-made lamps which proved most unsatisfactory; the wiring contractors in the town got hold of this and worked it for all it was worth. They now divided their lamp contracts among the principal English makers.

Mr. Howell thought it was rather unfair to say that all the improvements in lamps must be made by the maker: what was wanted was the aid of the lamp users. In the United Kingdom at the present time there were something like 1 million KW. of plant laid down, of which about 600,000 KW. were used for private lighting only, and the way in which lamps were used, made a most unsatisfactory condition of affairs. If the supply station engineers would co-operate with the lamp makers towards improving the methods of using lamps, he felt sure the quality of the lamp would improve. In the use of high-efficiency lamps, a steady voltage was of primary importance; if lamps were operated on a voltage constantly 4 per cent. high, their life would be reduced from 100 per cent. at normal voltage to 44 per cent. There was a definite relation between the watts per candle-power, and the life of lamps, He particularly wished to emphasise the importance of co-operation between the supply station engineer, representing the consumer, and the lamp maker.

Mr. Dickinson thought they did not sufficiently appreciate the value of the lighting load. It was the lighting load that made the profit, and the other load that lost it. They ought to try and keep the power prices up as much as possible. With reference to the keen competition with incandescent gas, there was no doubt in his mind that that was a serious matter. In Leeds some people were taking out electric lamps from the inside of the shops, whilst still keeping the shop windows lit. With regard to the lamps mentioned by the author, he could not find anything of a similar nature in Leeds. Since reading the paper he had sent a man round to pick out some lamps from different installations, and had had them tested; the worst ones showed 4·99 watts per candle, whilst some of them were down to 3·5 and 3·6. He thought the author had overdrawn the case a little. He did not think there was any precedent to allow the undertaker to specify the type of lamp the consumer should use. If the wiring contractors would not do what the undertakers required, they would have to educate the consumer to buy fully tested lamps. It was entirely out of the question to lay separate mains for lighting and power.

Mr. Wilson, speaking from the manufacturers' side, said he was not sure that the question of grading lamps could be settled in the way the Standards sub-Committee anticipated. It was an unfortunate fact that no lamp maker could make lamps for a given voltage and guarantee that all the lamps would turn out to that particular voltage when finished. This necessarily meant that every lamp maker must have a number of outfalls which did not come into the voltages for which they were intended. If they issued specifications with narrower limits than those existing at the present time, they must bear in mind that the price of lamps would go up instead of down, and a rise in the price of lamps would have a very bad effect upon the trade. The American system of grading voltages was far superior in every way to the one existing in England. They had in their factory a very large proportion of orders for, say, 200-volt and 220-volt lamps; they executed these orders and had left on their hands out of both classes a number of lamps which would come into, say, the 210-volt class. For these lamps they had no demand; if they broke them up, somebody must pay the cost of manufacture, this, of course, meant the consumer. The Standards Committee proposed to standardise the voltages at 220-volt, allowing a 10 per cent. margin on either side. Mr. Wilkinson stated in his paper that it was possible to keep his voltage within 2 per cent. What difficulty would there be in the way of station engineers arranging to have a different voltage in each town, the greater number to have, say, 220 volts or 110 volts, and varying on each side in steps of, say, 5 volts? By proportioning the number of stations with each voltage to suit the lamp makers, they would not interfere with the standardising of their motors and other apparatus, but it would certainly help the lamp makers in grading their lamps, and they would undertake to supply a more efficient lamp, graded nearer than even Mr. Wilkinson or the Standards Committee were asking for, and finally they would cheapen the lamps to the consumer. The central stations in America were closely allied to the lamp manufacturers, and if it was found in their lamp works that they had a percentage of outfalls for which there was no demand, in the next central station which was put down the voltage was graded to suit that particular line. Mr. Wilkinson mentioned the bad results of varying pressure, but had not mentioned that where the voltage was considerably over-run the consumer had to pay for this increase, and got less satisfaction from his lamps. A nominal 3½-watt lamp over-run 2 per cent. became a 3·5-watt lamp; at 4 per cent., 3·3 watts; at 6 per cent., 3·0 watts. They had obtained a number of lamps from consumers which they termed "black," and, according to the density of the blackening, the results showed from 15 per cent. to 40 per cent. loss in candle-power. Mr. Wilkinson gave some sample figures of the watt consumption of various lamps which he had found; but one could hardly believe that any British maker would knowingly send out lamps of this description. Evidently the 32-C.P. lamp which Mr. Wilkinson tested was originally 50 C.P., and was supplied in error. The total wattage of a 32-C.P. lamp should not exceed from 110 to 120 watts. At various times they and other makers had supplied for circuits which they knew to be continuously over-run, some less efficient lamp than they would have supplied, had they known the circuit to be run at the normal voltage. If these lamps were tested at the normal voltage, there was no doubt that the candle-power would appear too low. It was a fault which must be laid entirely on the station engineer that the general public believed that the lamp must be made to last 1,000 hours. They had tried for some considerable time to induce people to believe that the higher efficiency lamp at the prevailing price of energy would be the cheapest lamp to burn; but, being in the unfortunate position of lamp makers, they had been looked upon with great suspicion. Consumers should be educated to the fact that they could not get high-voltage lamps in the same small bulb as previously supplied for low voltage. Closer co-operation between the manufacturers of lamps and station engineers would be a very great advantage.

Mr. Emmott said that too little attention had been paid to the consumer in the past, and it would be well to take a wrinkle from the gas industry. Consumers required educating, and he had found that they were ready to fall in with reasonable suggestions as to getting the best lamps, weeding out the bad ones, and keeping the lamps and shades reasonably clean. Many good lamps lost 15 per cent. of their illuminating power simply through an accumulation of dust.

Mr. Hartnell said that if Mr. Wilkinson had tested the bad lamps on the voltage that best suited each individual lamp, he would probably have found very little difference in the watts per candle. He held that the consumer had a perfect right to do as he pleased. He saw no objection to the Corporation supplying lamps, providing it were done at a profit on business lines.

Mr. Rosling did not think there would be any objection to Mr. Wilson's suggestion of varying voltage at different stations, from the motor point of view. Lamps had very much to put up with; on the network, especially when a good way out from the centre, he had known the pressure vary from 10 per cent. below to 10 per cent. above the normal in the space of half an hour.

Mr. Rogerson thought Mr. Wilson's proposal a very good plan indeed. He was quite with Mr. Rosling that 5 or 10 per cent. difference in the pressure had no serious effect on the motors.

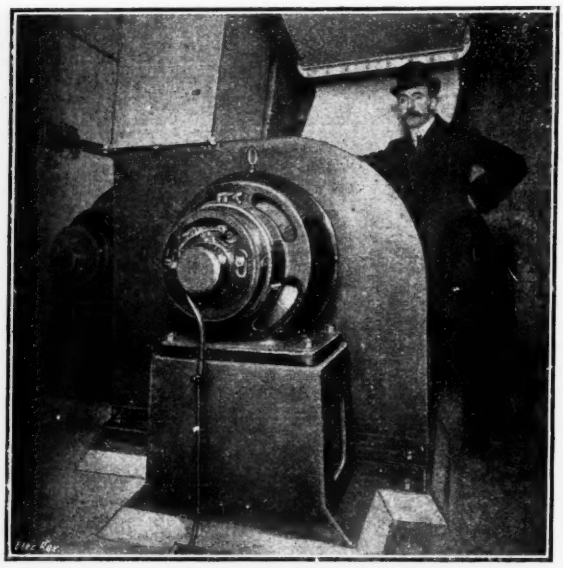
Mr. Corbingham said that Clause 18 of the 1882 Electric Lighting Act did not lay down any new law, but was merely declaratory of the common law, or rights of persons. There was no chance of its being done away with. If the average cost had been obtained, as he surmised it had, by the addition of all the average costs in the table, divided by the number of average costs, it was not correct unless the author had taken into consideration the various outputs attached to the average costs.

Mr. Wilkinson, in reply, said, regarding the examples of wasteful lamps given in his paper, that he had come across numbers of equally bad cases of more recent date. The 32-c.p. 100-volt lamps, taking an average of 170 watts each, were British lamps made by one of the best known firms, and they were returned. The saving in this instance amounted to £108 during the last twelve months. If motors were so erratic that the voltage varied and destroyed the regulation he said: "Give the lighting the first place, and take some means to put the motors on circuits so that they will not prejudicially affect the lighting load." As long as they had lamps with carbon filaments they must keep the regulation within 2 per cent. He would help the contractors, because they helped him a very great deal. He did not agree with municipal authorities taking hold of every branch of business and carrying it on in competition with ratepayers in their districts. It was very clear from Mr. Blackman's admissions that the Bradford Corporation had got into hot water through supplying inefficient foreign lamps; he thought it was time they did. He made a test of 90 Nernst lamps, and took careful note of each one, and obtained an average life of 520 hours; they were fixed in street lamps and subject to vibration. He believed the long average life was attributable to the good pressure regulation.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

The Ventilation of an Underground Sub-Station.

The accompanying illustration shows the ventilating plant employed at the Notting Hill Gate sub-station of the Central London Railway. Owing to the high temperature prevailing in this



Two "Sirocco" Centrifugal Fans Used for Ventilating the Notting Hill Gate Sub-Station of the Central London Railway.

station, which is situated at a depth of 90 ft. below the ground level, it was found necessary to install a special ventilating plant. The plant comprises two motor-driven fans, (supplied by Messrs. Davidson & Co., Ltd., of Belfast), which are installed in a separate chamber on the ground level immediately below the main entrance to the station. Each set consists of a 25-in. "Sirocco" centrifugal fan, direct-connected to a 5½-b.h.p. motor, running at a speed of 530 r.p.m. At this speed each fan is capable of dealing with 10,000 cb. ft. of air per minute against 1 in. water gauge, and requiring for the duty about 3½ h.p. The fans draw the air from the station by means of two 30-in. galvanised pipes, which pass down on each side of the lift pit. The overhead duct, which is shown coming forward at the top of the accompanying photograph, passes down the west side of the pit, while the duct at the back of the photograph goes down the east side. The vertical duct is the combined discharged duct for both fans, and discharges the air through the main entrance and through the roof of the station into the atmosphere. Each of the fan intakes is fitted with a swing damper, as is also each of the branches to the vertical ducts, so that either, or both, the fans can draw from either, or both, the vertical ducts. When both fans are in operation the average temperature in the sub-station is about 70°, but if they are shut down for even 10 or 15 minutes the heat in the station becomes almost unbearable.

G.E.C. Accessories.

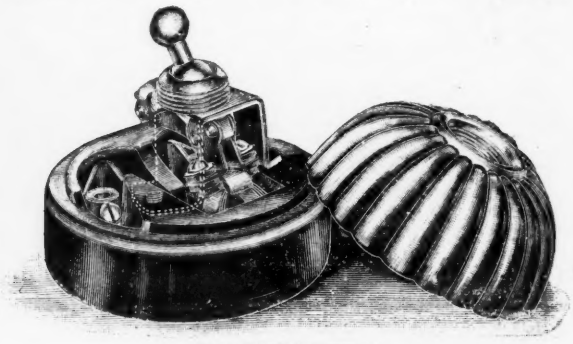
In their February Progress Sheet, the General Electric Co., Ltd., of Queen Victoria Street, E.C., illustrate a number of new lines, including the B.C. bracket fitment, a device introduced for meeting the convenience of the consumer who desires to remove electric light bracket fittings from the wall for cleaning or other purposes. One part of the device is fixed to the wall, and the other adapts the bracket for fitting into it. Battery ringing telephones, covers for Nernst lamps, and several switches are included in this sheet, and some reductions in prices of Geeko direct working

Water-tight Quadrant Branch Switch.

telephones are listed. The watertight "Quadrant" branch switch of the pull-down pattern we illustrate herewith. It consists of a quadrant movement enclosed in cast-iron water-tight case, the "on" and "off" movements being operated by means of the finger pull at the base of the case; at the top provision is made for the incoming wires. A new leaflet has been issued by the company notifying the reductions which have been made in the prices of "Geeko" ignition accumulators.

The "L.B." Switch.

Messrs. C. H. Davies & Co., of Francis Street, Birmingham, who are manufacturers of electrical accessories, have sent us a sample of one of their L.B. (long break, laminated brush) patent switches. The advantages claimed for this switch, which is of simple



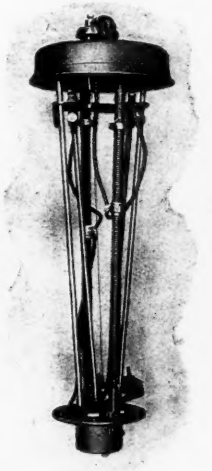
The "L.B." Switch.

but clever design, are that it has no live metal parts at back, has a laminated copper contact maker, and has an exceptionally long break, with a strong spring action; its handle is jointed direct to the contact maker, thus making it impossible to move one without operating the other. The base is of best English porcelain, and ebonite insulation is used between the handle and the live parts. The firm manufactures these switches (in England of course) in 5, 8 and 10-ampere sizes, and for 250 volts or higher.

The "Juno" Flame Arc Lamp.

Messrs. Johnson & Phillips, Ltd., as mentioned a week or two ago, have entered the arena with a flame lamp of very simple design. As will be seen from the illustration, there is in this lamp a total absence of clockwork and other small parts which might enhance the price. The two carbons, which are of small diameter, are arranged so as to converge towards their lower ends, and the arc is formed between these ends inside a metal cup. The carbon holders are connected together by two cross slides, which cause them to travel up and down at the same rate. No chains or pulleys are used to obtain this result. The lower end of one of the carbons rests on a copper abutment piece, so arranged that as this carbon burns away it falls by gravity, and as both carbons travel at the same rate, the arc is always formed in exactly the same place within the metal cup. The second carbon at its lower end, and just above the metal cup, passes through a striker, which, on the current being switched on, causes the carbons to separate. This action is brought about in some patterns by the expansion of a wire heated by the passage of the current, and in other patterns by the action of a series coil. The diagram shows the hot-wire lamp. No shunt coils are used, however many lamps are in series, as the arc is always the same length. In order to keep the arc from travelling up between the carbons, a blowing magnet is used. This consists of bare copper wire wound on insulated rods, and can be readily adjusted so as to give the exact amount of blow required. The simplicity of the lamp is due principally to the absence of any brake, clutch, or other feeding arrangement, the place of which is taken by the copper abutment piece mentioned above. It would be thought that the position of this abutment piece would cause it to rapidly burn away, but it is found that with constant usage this part will last about three months, and it can be readily replaced at quite a nominal cost when trimming the lamp. The carbons are of a special quality made for use in this lamp, and are not of the metal cored variety. Only a small amount of ash is formed, and scarcely any fumes are given off by these carbons. We are informed that to a large consumer, the cost of carbons for these lamps will work out to a little over one-tenth of a penny per lamp hour. An effort has been made to keep the lamp down to a reasonable size, the overall length of the 10—12-hour lamp being 29 in. A stout copper case is provided, the exact form of which can easily be varied to suit special circumstances.

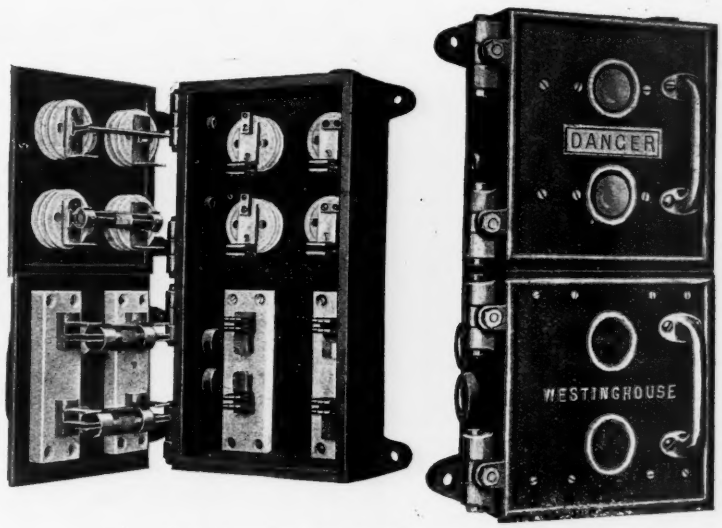
The 'Juno' Flame Lamp.



The "Juno" Flame Lamp.

Transformer Fuse Box.

The British Westinghouse Co. have recently placed on the market a new and convenient fuse or switch box, which can either be fixed to an existing wall, or mounted on a pillar. Intended for use in transformer sub-stations and similar positions, it provides a convenient and safe means of protecting and isolating both the high and low tension sides of a transformer or other apparatus. The box was originally designed for the requirements of the County of London Electric Supply Co., Ltd., for use in their sub-stations, but the design covered so many novel points, and filled so many requirements, that the British Westinghouse Co. decided to make it a standard manufacture. Fig. 1, in which is seen the cast-iron framework of the box, shows also the inspection windows, the cable bushes, the division of the door, and the lugs for fixing to wall; and in fig. 2 are shown the H.T. and L.T. connections and the mountings. The cables from and to the transformer are led in through insulating bushes. The H.T. terminals are mounted on porcelain insulators, and the L.T. on treated marble slabs. These terminals are combined with jaw clips, into which the knife-blade ends of fuses or isolating switches enter. The fuses or switch blades are carried upon porcelain insulators or marble bases, fixed to the inside of the hinged cover. The action of closing the box automatically completes the circuit, and similarly the circuits are broken on opening the box. The fuses are of the enclosed type, the rupture of the circuit taking place inside a totally closed tube, thus rendering flashing or arcing impossible. In the box illustrated one fuse is provided in the H.T. circuit, and two in the L.T. circuit, but any combination of fuses or isolating links can be arranged. An important feature of the box is the construction of the cover. This is in two halves, and it is impossible to open the lower, or L.T., half without previously opening the upper, or H.T., portion. Thus, none of the fuses can be replaced until the H.T. supply to the transformer is cut off. Inspection windows are provided in each half of the box so that the condition of the fuses may be ascertained without opening the doors. Convenient handles and bolt lugs are provided. The whole arrangement is compact, and the over-all dimensions of the box shown in the illustrations are 2 ft. × 11 in., a size which is suitable for all purposes up to 2,500 volts on the H.T. side.



The Westinghouse Transformer Fuse-Box.

Coatbridge Tramways.—The Tramway Committee of the T.C. has been asked to approach the Glasgow Corporation, through the County Council, on the question of the extension of the Glasgow system from Baillieston to Coatbridge.

REVIEWS.

Modern Electricity. By James Henry, M.E., and K. J. Hora, M.Sc. London: Hodder & Stoughton. 1905. Price 5s.

This book claims, so says the title page, to be "A practical working Encyclopædia and Manual of Theories, Principles and Applications." We should wish to stop here were it not our duty to those who are not capable of reading the book critically—we mean elementary students—to give a warning word. The book is unscientific from beginning to end.

We can forgive an occasional numerical or clerical error, but when the very fundaments are incorrect it is time to speak out.

We are told on page 23 that a "body from which electricity flows is said to be positively charged, the other negatively." Again, on page 24 "electrical energy is not used in the same quantity for all purposes. For some purposes it is used in the form of a small quantity falling through a great difference of potential, while for other purposes we must have a large quantity of *electrical energy* falling through a small difference of potential." Who ever heard of electrical energy falling through a difference of potential?

On page 26, again, in a hydraulic analogy, we are told that *pipe* can be substituted for *wire*, &c., and *water meter* for *wattmeter*.

On page 68 the expression "a current of 1 volt pressure" is used.

On page 71 we are told that "the amount of heat is equal to the number of watts."

On page 85, "the magnetic pressure is *due* to a difference of potential."

On page 106, "The magnetic field of a current induced by a change in a magnetic field, opposes this change."

On page 160, "*The effective pressure of an alternating current* is the value which, when multiplied by the effective current set up by it in the circuit, gives the power expended in the circuit." The effective current (or effective pressure) is defined as the root mean square value.

We have quoted only a few of the absurdities of the book. We shall not dwell further on it, except to advise no one who wants to learn to buy the book.

For the publishers' sake we must, however, add that the printing and general get-up are excellent.

Wireless Telegraphy and Hertzian Waves. By S. R. Bottone. London: Whittaker & Co. 1905. Third Edition. Price 3s.

This little work is divided into three main parts—the theoretical introduction, the historical and descriptive part, and a section devoted to simple methods of construction of some of the apparatus used. No part can be said to be thoroughly sound and good. The theoretical part starts off with a misleading piece of information, viz., that "electricity appears to be a vibratory motion in the ultimate molecules of bodies," and finishes up with the statement that it appears to be a species of wave motion in the molecules. Misrepresentations of this kind do not conduce to confidence in the ability of an author to convey accurate information on the subject. The historical and descriptive part is scanty and indicative of lack of discrimination in the selection, none of the most modern and approved systems being described. The constructional part is largely devoted to details of apparatus of very questionable utility. An appendix on "Wireless Telephony" contains nothing of any practical value.

In the preface to this (third) edition the author states that an effort has been made to describe and illustrate the more recent developments of "wave" telegraphy and telephony. A perusal of the book fails to find that the effort has borne any fruit.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1904.

Electric Vapour Apparatus, Especially Electric Lamps of the Character known as Electric Vapour Lamps, or Vapour Arc Lamps. C. O. Bastian. 28,147. December 21st.

Appliance for the Commutation of Current in Armatures of Dynamo-Electric Machines. E. Arnold and J. L. La Cour. 28,416. December 27th.

1905.

Devices for the Electro-Graphical Long-Distance Transmission and Reception of Drawings, Photographs, and the like. H. Carbonnelle. 16,796. August 18th.

Commutators of Dynamo-Electric Machines and Electric Motors. W. Armistead. 16,971. August 22nd.

Electrical Hand Lamps. C. G. Napier-Clavering. 17,270. August 26th.

Microphones for Use in Submarine Signalling. H. H. Lake. (Submarine Signal Co.) 17,722. September 1st.

Electrical Safety Devices for Guarding Against Burglary and the like. C. Jacob. 23,298. November 13th.

Reversible Galvanic Battery. C. B. Askew. 18,381. September 12th.

Electric Furnaces. P. Girod. (Date applied for under International Convention, December 24th, 1904.) 23,402. November 14th.

Electric Meters. C. W. Atkinson. 1,221. January 21st.

Railway Electric Signals. S. W. Huff. 1,321. January 23rd.

Electrical Contact Makers and Breakers. P. W. Noble. 1,482. January 25th.

Electrical Contact Makers or Breakers. P. W. Noble. (Date applied for under Rule 5 of Patents Rules 1905, January 25th, 1905.) 1,482A. January 25th.

Electroliers and Electric Wall Brackets. G. Shilvock. 2,299. February 6th.

Electric Signalling Systems and Apparatus Therefor. British Thomson-Houston Co., Ltd. (General Electric Co.) 2,691. February 9th.

Transformer for Electric Metal Working Apparatus. W. L. Wise. (The Thomson Electric Welding Co.) 4,075. February 27th.

Brakes for Electrically-Driven Machinery. F. O. Hunt. 4,497. March 14th.

Magneto-Electric Generators. L. A. Gianoli and R. A. Persin. 7,111. April 4th.

Construction of Electric Arc Lamp. H. Diamant and A. Chiesa. 9,783. May 9th.

Electrical Switches. P. S. Griffin. 10,265. May 16th.

Terminals for Electric Cables. M. A. Codd. 11,012. May 26th.

Electric Welding Apparatus. H. H. Lake. (The Clinton Wire Cloth Co.) 14,782. July 18th.

Insulating Sleeves for Electric Wires or Cables at a High Potential. P. Coridori. 14,889. July 19th.

Automatic Electric Circuit Breakers. Lionel Robinson & Co., Ltd., and J. D. Adams. 15,819. August 2nd.

Enclosed Dynamo-Electric Machines for Effecting the Ventilation Thereof. Siemens Bros. & Co., Ltd. (Siemens Schuckertwerke G.m.b.H.) 16,300. August 10th.

Means for Facilitating the Erection of Telegraph Poles and the like. J. R. Brown. 20,728. October 13th.

Telephone Receivers and the like. R. B. Bumiller. 21,162. October 18th.

Electro-Magnetic Coils for Treating Live Animal, Live Vegetable, or other Objects. J. McIntyre. (Date applied for under International Convention, October 29th, 1904.) 21,833. October 26th.

Omnibus Electrical Signalling Circuits Particularly Applicable in Telephony. C. M. Jacobs. 22,820. November 20th.

Appliances for Carrying Suspending Globes for Inverted Incandescent Gas, Electric and other Lamps. W. Anderson and H. Anderson. 24,475. November 27th.

Electric Traction Systems. W. S. Boult. 2,172. February 3rd.

Electric Cables. C. J. Beaver and E. A. Claremont. 2,747. February 10th.

Secondary Electric Batteries. P. Marino. 4,287. March 1st.

Electrical Apparatus for Transmitting and Receiving Signals. A. T. Dawson and G. T. Buckham. 4,741. March 7th.

Electric Distribution Systems and Controlling Apparatus Therefor. British Thomson-Houston Co., Ltd., and E. B. Wedmore. 4,878. March 8th.

Electric Switches having Resistances. E. Garside. 6,383. March 25th.

Dynamo-Electric Machines. British Thomson-Houston Co., Ltd. (General Electric Co.) 6,595. March 28th.

Apparatus for Electro-Plating Tubes or other Hollow Articles. I. Potthoff. 6,790. March 30th.

Insulation-Cutting Contact Clip for Electric Cables. T. B. Reader. 6,834. March 31st.

Electrical Contact Breakers for Induction Coils and the like. G. Bowron. 7,019. April 3rd.

Electric Lamps. Particularly Applicable to the Tail Lamps of Motor Vehicles. J. W. Greenwood. 7,444. April 8th.

Controllers for Electric Motors. British Thomson-Houston Co., Ltd. (General Electric Co.) (Date applied for under Rule 5, Patents Rules 1905, April 12th, 1905.) 7,822A. April 12th.

Electric Distant Gas Lighting Device. A. Mautz. (Date applied for under International Convention, April 27th, 1904.) 8,759. April 20th.

Electric Contact Devices. J. J. Walker. 9,401. May 4th.

Electric Resistance Furnaces. J. F. Bottomley and G. Paget. 9,522. May 5th.

Dynamo Construction. H. Leitner and R. N. Lucas. 9,655. May 8th.

Electric Accumulators. A. Gouin. (Date applied for under International Convention, May 9th, 1904.) 9,657. May 8th.

Connectors for Electrical Conductors. British Thomson-Houston Co., Ltd. (General Electric Co.) 9,908. May 11th.

Systems of Electric Train Lighting. H. Leitner and R. N. Lucas. 10,118. May 13th.

Electric Batteries. D. Fuller. 11,040. May 26th.

Single-Phase Alternate Current Electrical Motors Provided with Commutators. Elektrizitäts Akt.-Ges. vorm. W. Lahmeyer & Co. (Date applied for under International Convention, July 11th, 1904.) 11,440. May 31st.

Electric Purifier for Use in Purifying Flour, Grain, Rice, and other Substances. J. L. Lawson. 13,909. July 6th.

Electrical Igniting Device for Explosion Engines. S. Bullock and A. R. Bullock. 14,323. July 11th.

Electric Alternating Current Machines. P. A. J. Lapeyrade. (Date applied for under International Convention, August 23rd, 1904.) 16,905. August 21st.

Incandescence Bodies of Tantalum Wire for Electrical Glow Lamps. Siemens & Halske Akt.-Ges. (Date applied for under International Convention, October 13th, 1904.) 18,403. September 12th.